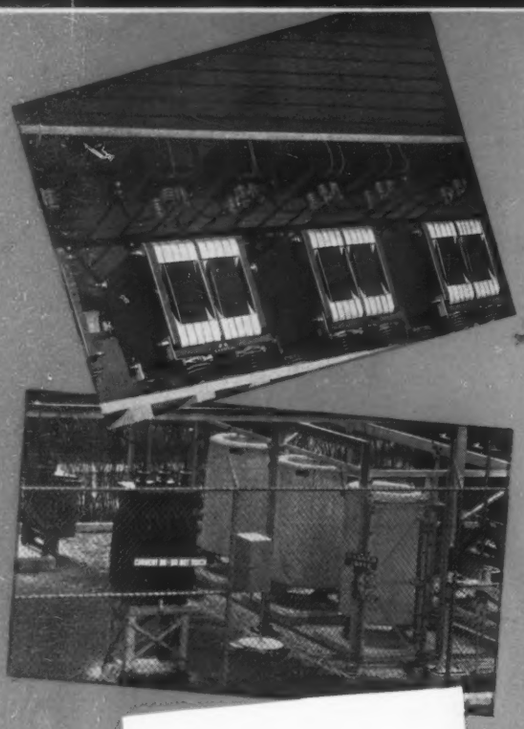
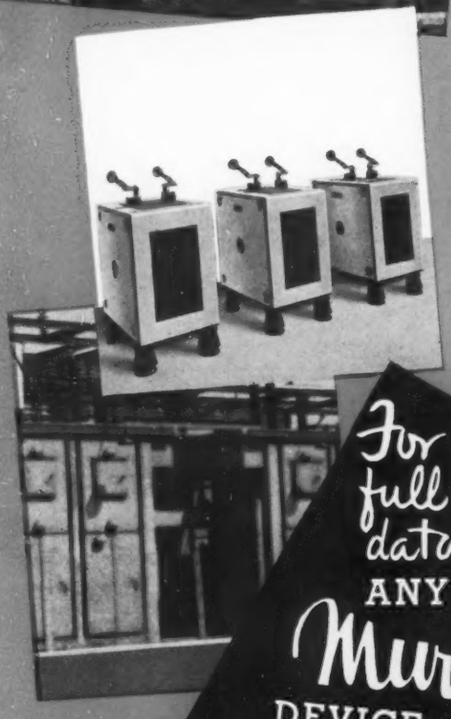
Electrical World

JANUARY 25, 1941

MINIATURE AIDS TRANSMISSION TERMINAL DESIGN





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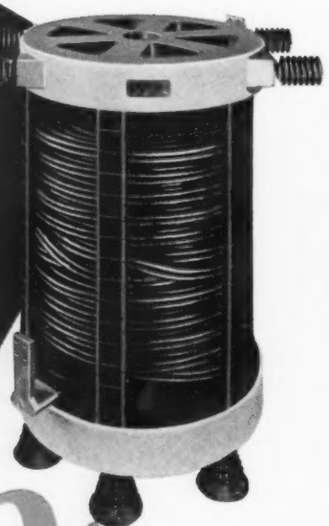

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January 25, 1941

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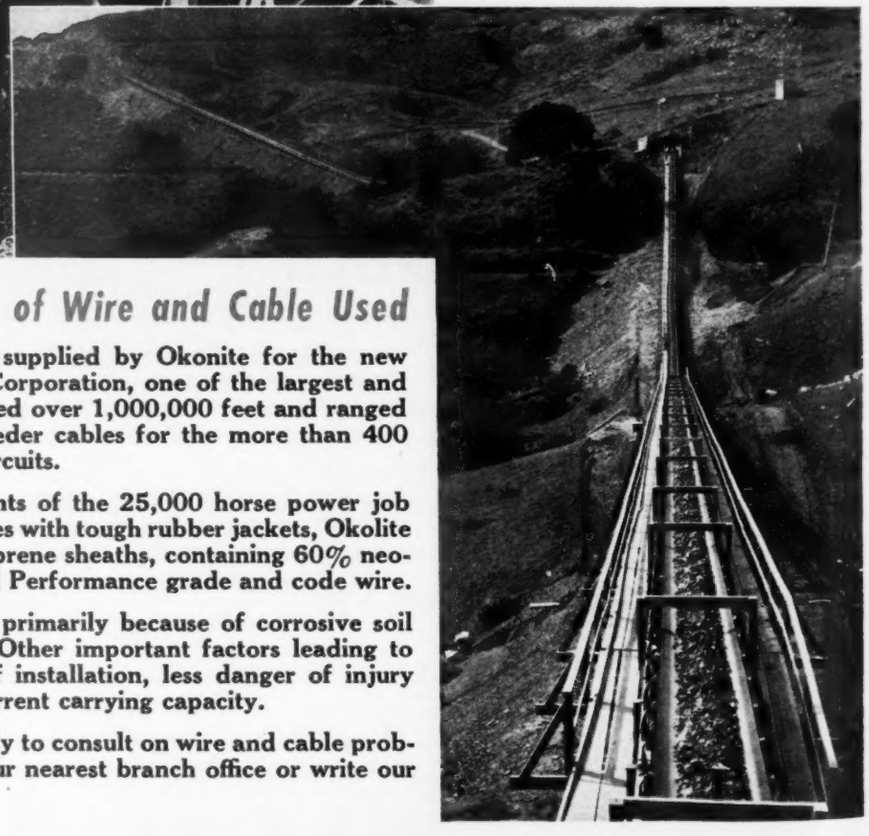

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Conventions During Emergency

It hardly seems possible that any other industry can have as many meetings as the electrical. Not only are there national associations for different segments of the industry but there are regional, state and local bodies as well as committees which meet regularly. What will happen to the meetings this year? Will they be maintained or be on the same scale or have the same kind of programs?

Announcement has been made that the Automobile Show will not be held this year. Is that a forerunner of similar announcements with regard to conventions? Already one national electric meeting has given way to a small, short executive conference.

Annual meetings of associations have always played a big part in the industry's co-operation. Not only have the business sessions been of value, but the social and recreational side has been of untold benefit in building and cementing friendships that have proved their worth to the business many times over.

Association officials are going to be faced with a dilemma this year. Because these are busy times, shall the convention be abandoned or held to a single-day business session? Or shall the very tiredness of men be recognized and a meeting with normal recreation be provided as a relief for jaded nerves? There is something to be said on both sides.

During the previous World War it was found inadvisable to eliminate conventions entirely, and now, with larger problems, it would seem as though meetings properly planned were more important than ever. More attention, however, must be given to program planning. What are the problems that are bothering people? What do people want to know about? Who are speakers that will get down to bedrock and not just mutter a few platitudes?

It has become a fairly widespread practice for conventions to listen to non-member speakers. In times of peace this practice has its place because it brings in the outside viewpoint. This year, however, there are so many internal problems it might be advisable to draw the speakers more from within.

The attendance this year might not be as large as it has been, but what the meetings lack in numbers they can easily make up in the quality of the sessions. This can be heightened by a greater degree of informality—by a series of round tables, panels and similar devices to intensify discussion.

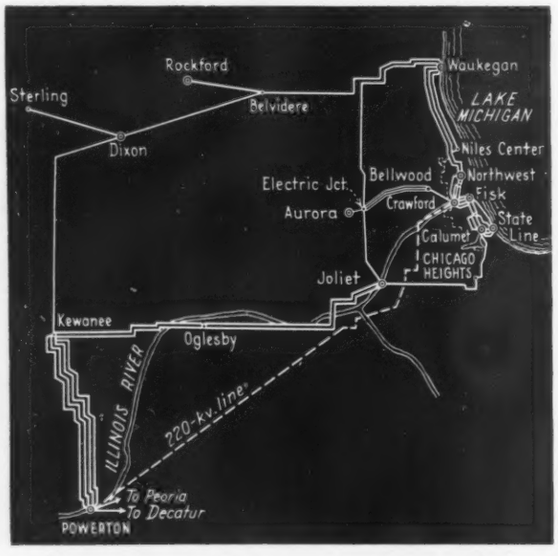
There isn't any reason, so far as we can see, for associations to eliminate their meetings this year. There may be several reasons for changing their character. Especially is there reason for fitting the program definitely to the problems of the moment.

Powerton-Crawford 220-Kv. Line Part I—Terminal Design Features

Factors involved in operation and handling of world's largest transformers and synchronous condenser influence design of Chicago terminal of Commonwealth Edison's new 220-kv. line — Condenser performs dual function of voltage control and line energizing

T. G. LeCLAIR and P. N. SANDSTROM,† Commonwealth Edison Company, Chicago*

POWER SUPPLY for the Chicago and northern Illinois area served by Commonwealth Edison and affiliated companies is drawn from two generating stations on the shores of Lake Michigan and four generating stations located on the branches of the Chicago River. Another generating station is located at Powerton, near Peoria, Ill., about 150 miles southwest of Chicago, where the flow of the Illinois River and its tributaries is available for condensing water. This station supplies a substantial load in the areas west and southwest of Chicago in addition to sending a considerable amount of energy to the city of Chicago.



NEW and shorter routing of supply from Powerton station to the city of Chicago by 220-kv. transmission as compared to 132-kv. transmission

Powerton station is adjacent to a low-cost coal supply and is within the limit of the distance where the cost of transmitting power electrically is approximately balanced by the cost of hauling the coal to the city from the mines near the Powerton station.

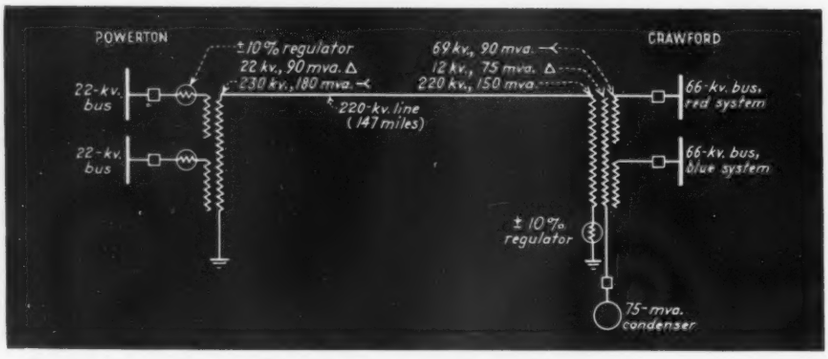


DIAGRAM of 220-kv. transmission line and terminal equipment

The Powerton site was originally selected to serve load in the adjacent area. However, it is economical to transmit power at high voltage from the station to Chicago. At the time the project was authorized, in 1928, 220,000 volts was the highest commercially practicable voltage and this voltage was adopted because it permitted delivery of 150,000 kw. over a single-circuit transmission line.‡ A schematic diagram of the complete project is shown herewith.

This 220-kv. line, with one or two generators at Powerton, is maintained as a separate unit delivering power to the Chicago system at Crawford station, on the west side. The 132-kv. system delivers power to the Chicago system at Calumet on the south and at Northwest on the north. To maintain these three sources of power as independent units, the Powerton generators connected to the 220-kv. line are not synchronized with the other machines at Powerton station. They are synchronized with the remainder of the system only through the Chicago 66-kv. bus.

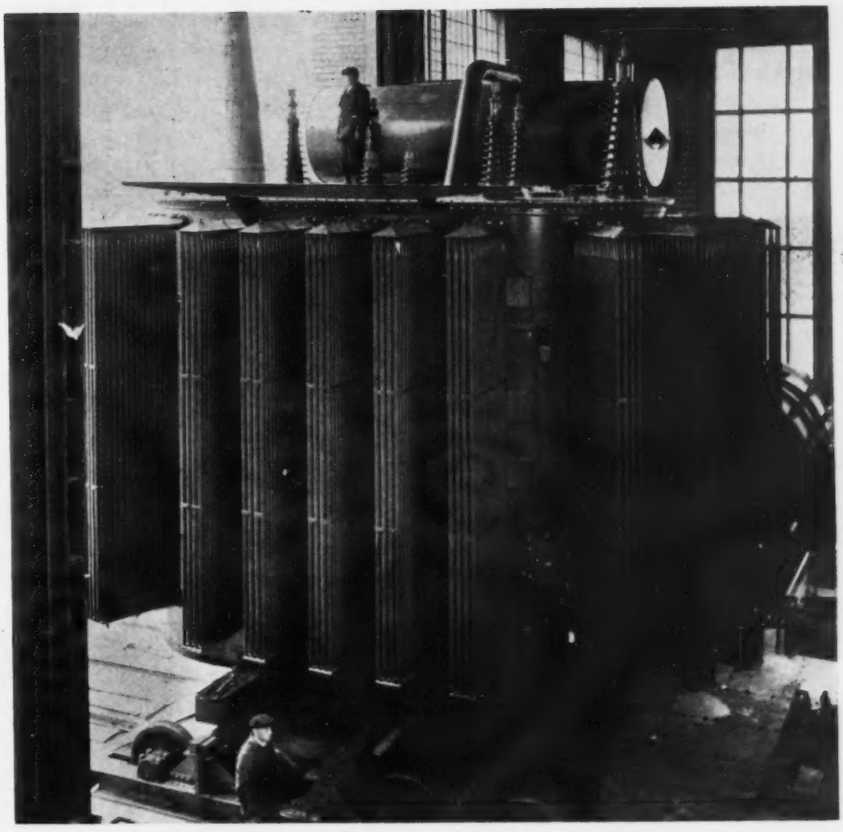
Transmission loss on the line, including the losses in transformers and the synchronous condenser, is approximately 7 per cent. Coal cost of Powerton is so much lower than the coal cost for any Chicago station that the line and connected generators operate normally at a load factor in excess of 80 per cent.

The major elements in the 83,000-sq.ft. Crawford terminal include

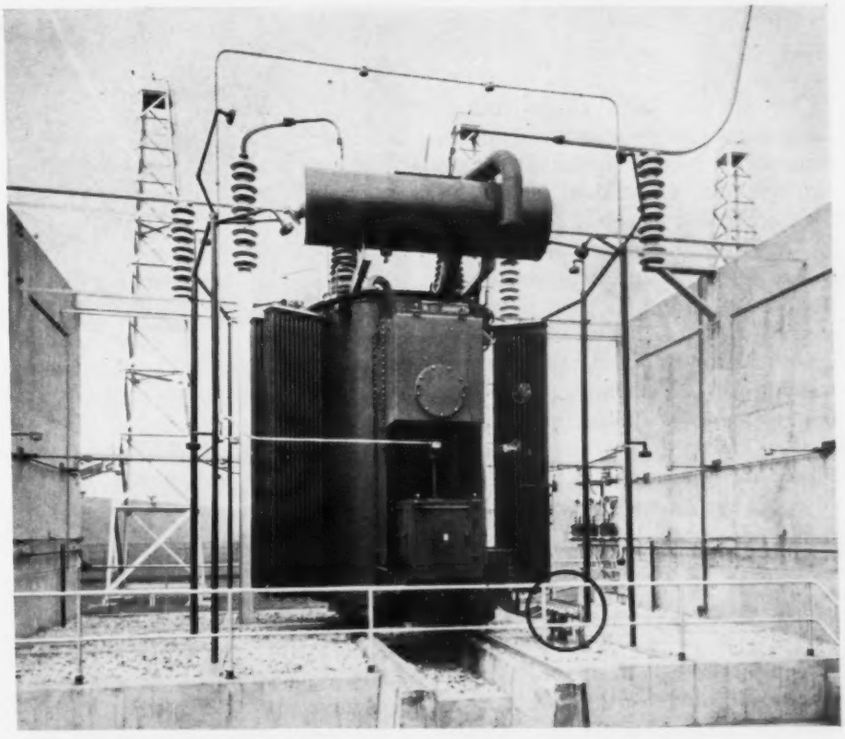
* Supervising development engineer.
† Supervising planning engineer.
‡ Discussion of line design and construction will be the subject of a subsequent article to appear in "Electrical World."

four single-phase, four-winding transformer units, the largest ever built, with an equivalent capacity of 67,500 kva. A 75,000-kva. synchronous condenser is provided to control voltage and as a by-product it affords a convenient means of energizing the line. To house this synchronous condenser, also the largest of its kind, and to provide means for assembling and handling the huge transformers, required a specially designed building. A 200-ton crane that traverses the entire building and a pit at one end permit transformer handling without increasing headroom over the synchronous condenser unit.

Powerton terminal differs from Crawford terminal because it has no synchronous condenser and for other local reasons to be mentioned later. Fire protection of the large transformers and lightning protection for the expensive equipment were important elements in the design of both terminals.



SINGLE-PHASE, 220/69-6/12-kv. transformer on special truck for easy handling. Transformer is 31 ft. high over all and occupies 21 x 29 ft. of floor space



TAP CHANGING UNIT, 5,000 kva. for ± 10 per cent regulation of 220-kv. transformer at Crawford terminal. In circle is seen the special control connection for rapid disconnection when replacing regulator

Transformers

Each single-phase transformer at Crawford terminal has the following winding ratings: One 220-kv. winding, 50,000 kva.; two 69-kv. windings, 30,000 kva. each; one 12-kv. winding, 25,000 kva. The equivalent two-winding capacity is, therefore, 67,500 kva. per unit.

Transformers of this size could not be shipped assembled within allowable clearances over any railroad routing, even with the radiators removed. To ship the core with coils it was necessary to build a special car with a very low clearance above the rail. The transformer core was inclosed in a sealed container filled with nitrogen to prevent moisture entering the insulation. This shipping tank was equipped with a special set of bushings to which the transformer winding was connected. When the shipment arrived at the station the transformer was excited at low voltage through this bushing and operated under short circuit long enough to bring the core and coils up to the operating temperature. The tank was then filled with oil to drive out any possible remaining moisture from the insulation before exposing the insulation to atmosphere.

Transformer core and coils were installed in the permanent tank, which had been previously assembled on the job, with only two or three hours' exposure of the oil-impregnated insulation to atmosphere.

This work was all done in the transformer handling pit, located in the condenser house. When completed each transformer without oil

was lifted from the pit and transferred to a special truck, capable of carrying the 250-ton total weight, wheeled out into the transformer yard and rolled from the truck onto the rails in the proper compartment. This truck is equipped with an electric motor drive, which can be connected by means of a gearshift, either to propel the truck or operate a winch that pulls the transformer on or off the truck. The 200-ton crane provided in the transformer handling house could not lift the complete transformer filled with oil, so the unit was filled with oil after mounting on the truck.

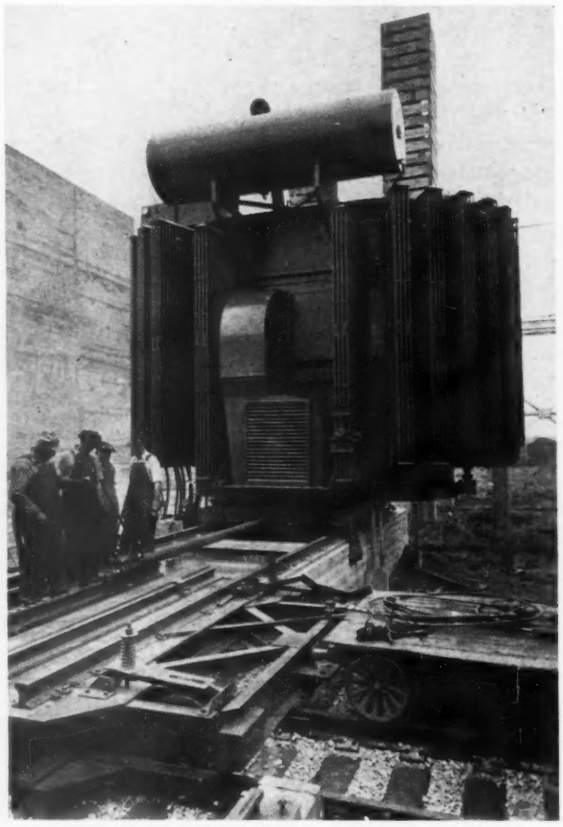
Three of the four single-phase transformers are used in normal operation. The fourth is installed on a spare truck adjacent to the transformer handling house. In the event of transformer trouble, the defective unit will be rolled out of the compartment and a spare unit rolled into its place. It is expected that a defective transformer unit can be removed and a spare unit returned to service in less than four hours in spite of the extreme size and weight of the units. To speed this operation the transformers are mounted on wheels, as previously mentioned, and all windings are attached to the leads through bolted connections which can be quickly removed. All low-voltage connections for temperature indicators, supply to cooling fans, etc., are through plug connections which can be quickly disconnected.

Transformer design was carefully co-ordinated for surge-voltage protection. In addition to this, lightning arresters are istalled on the 220-kv. leads within 50 ft. of the transformer bushing. As a further protection, the entire outdoor structure is covered with a network of ground wires which are connected to the ground wires on the incoming line.

Synchronous Condenser

The 75,000-kva. synchronous condenser operates at 514 r.p.m. and is air-cooled. Choice of air cooling was in part dictated by the fact that a building was necessary for transformer handling and the cost of a larger building to house the condenser compared favorably with the additional cost of making the condenser a hydrogen outdoor unit.

Normal practice is to start synchronous condensers as motors with reduced voltage. However, this condenser is to be used for exciting the transmission line with charging current of 37,000 kva. Therefore, it was necessary to equip the condenser with a separate 3,750-hp. slip-ring starting motor which could be used for this purpose. The starting motor is approximately twice as large as necessary for starting the condenser alone because the condenser will be brought up to speed carrying the load of the charging current of the high-voltage line and the core loss of the transformers at both ends of the line.



SINGLE-PHASE, 220/22-22-kv. transformer at Powerton; truck equipped with special jack for handling

Synchronizing this transmission line to the system cannot be accomplished by simply closing a circuit breaker without a sudden rise on voltage on the transmission system. The normal procedure to avoid the sudden application to the system of an equivalent 37,000 kva. leading power factor load caused by the line charging current is as follows:

The synchronous condenser at rest is connected to the Crawford transformer, which in turn is connected to the line and Powerton transformer. The synchronous condenser is then brought up to speed by the starting motor and enough field current applied to bring the line up to normal voltage. The line is then synchronized with the 66-kv. system at Crawford without voltage disturbance. The next step is to bring a generator at Powerton up to speed and synchronize directly with the line. If the Powerton generator is already in service connected to the 132-kv. lines, the 220-kv. line is temporarily paralleled with the 132-kv. system until one or two units are transferred.

Total weight of the condenser is 350 tons. The heaviest part is the rotor, which weighs 175 tons and determined the necessity for a 200-ton crane in the condenser building.

For cooling the unit air is drawn from outside the building through oil bath air filters, blown through the condenser and returned outdoors. The oil coolers are installed in the main air ducts. During cold weather part of the air can be bypassed into the station building to maintain a reasonable temperature. The cooling capacity is more than enough. During the adjustment period of the first two months special attention was necessary on cold days to keep the temperature of the lubricating oil on the bearings above 70 deg. F. at machine full load.

The synchronous condenser building provides space for both the condenser and transformer handling. The 200-ton crane, with consequent heavy steel work in the building walls, was necessary to handle the rotor for the synchronous condenser. The main part of the building was constructed with a crane clearance above the floor of only 35 ft., which is ample for the synchronous condenser dimensions. A maximum lift of 45 ft. was required for removing core and coils from the tank of the 67,500-kva. transformer unit. The south end of the building had the floor depressed 18 ft. to provide a 53-ft. lift from the bottom of the transformer handling pit. The space under the synchronous condenser was utilized for air coolers and other auxiliary equipment. This

arrangement resulted in an economical building for the two purposes.

Each transformer unit contains 24,000 gal., or approximately three carloads, of transformer oil. Handling this volume of oil and clarifying it requires special protection against fire. The oil-handling equipment is in a separate underground room immediately to the east of the synchronous condenser house and is separated from the main building with a concrete wall. Farther east is a separate underground room containing two 25,000-gal. oil storage tanks, one of which can be used for clean oil and the other for dirty oil in the process of changing.

A building extension to the south of the transformer handling pit contains a heating plant in the basement, a lighting switchboard on the first floor, a shop room on the second floor and a relay room on the third floor. Actual control of the synchronous condenser and the terminal is handled from the Crawford generating station operating gallery, approximately 1,000 ft. away, but the relays on the transformer bank and on the synchronous condenser are installed in this relay room of the condenser building.

Fire Protection

Fire protection was given careful consideration on this project, containing such large quantities of oil in a single transformer tank. Each transformer unit is installed over a pit filled with crushed rock to cool escaping oil in the event of a transformer fire. The depth of this rock is more than 3 ft., which is enough to absorb all the oil in a transformer tank. Also, each transformer and voltage regulator compartment is equipped with a bulk carbon dioxide fire-extinguishing system. This fire-extinguishing system is also provided with temperature relays to release automatically the carbon dioxide in the event of a sudden increase in temperature adjacent to one of the fire detectors. Elaborate tests were made on old transformer tanks before this fire protection scheme was adopted to insure that the arrangement of piping and nozzles would be satisfactory to put out any reasonable fire. The cover picture of this issue of ELECTRICAL WORLD shows a scale model of the complete terminal with the various parts in better perspective than any picture of actual equipment.

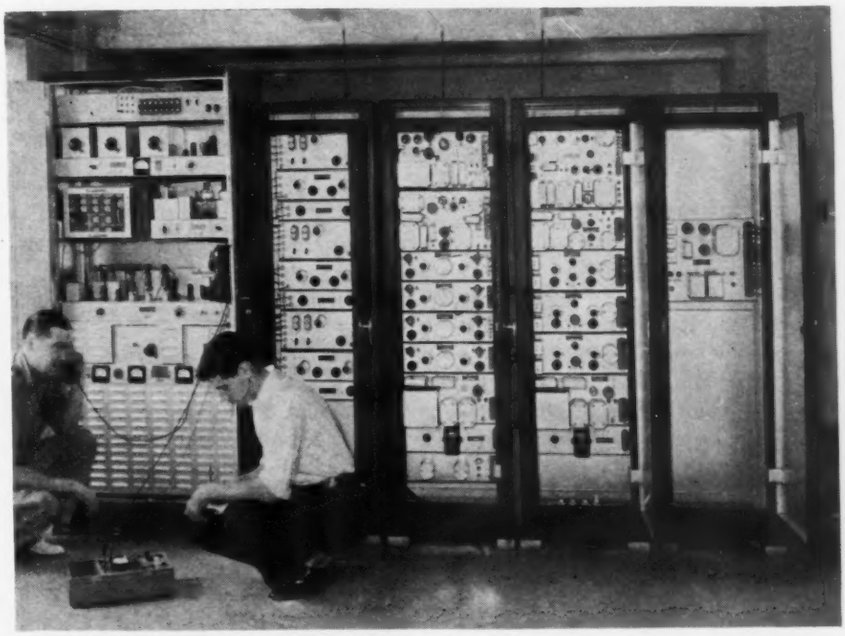
Some of the previous discussion applies equally well to the Powerton terminal. However, local conditions and the omission of a synchronous condenser dictated several important differences in design.

Powerton station is some distance from any available personnel to handle heavy machinery on short notice. Therefore, it was considered necessary to have the spare transformer and spare regulator units permanently installed, with electrical connections available to disconnect a faulty unit and replace it with a spare without actual moving of the transformer. With this arrangement, the time required to disconnect and replace a defective transformer will be approximately the same as at Crawford terminal, but without waiting for the services of machinery movers. Transformer truck and the hydraulic jack used to push the transformer into the compartment are illustrated.

No synchronous condenser is used at Powerton station. Therefore, the only heavy machinery which requires a building is the transformer-handling equipment. Most economical design of building for this single purpose proved to be one with the crane hook 62 ft. above the ground level. In this case the transformer unit can be rolled directly into the transformer house on this ground level.

On this line carrier current is used for an unusually large number of different purposes.

The lack of high-voltage circuit breakers makes it necessary to trip the remote end of the line for trouble in these large transformers. Carrier current is used as a part of the trip circuit in connection with the relaying to transmit the tripping impulse to the Powerton end of the line for trouble at Crawford, and *vice versa*. Three separate audio channels are used on the same carrier channel for this purpose. Two of these channels are used for blocking and continuous circuit checking and the third is used for tripping. A separate carrier channel is used for each direction. These two carrier channels are also used for telemetering in both directions and for control of the turbine loading at Powerton. A third carrier channel is used for telephone service, which is primarily for the purpose of direct communication for dispatching purposes. However, this carrier telephone set is normally available for routine business, but the dispatcher's offices at both ends have an emergency cut-off circuit.



CARRIER-CURRENT EQUIPMENT for one terminal; the larger unit to the left is for telephone communication; the other four units for telemetering, load control and remote control tripping; duplicate equipment is used at the other terminal

Placing Line in Operation

One important problem in preparing terminal equipment for service was the high potential test on the large transformer banks. An induced

[*Continued on page 92*]

Gaseous Tube Harmonics in Reference to Distribution

Conventional capacitor correctives limited in power-factor effectiveness by harmonics — T-assembly of X and C advantageous — Clause proposed for the limitation of influence and distortion factors

W. S. PETERSON and T. M. BLAKESLEE, Los Angeles Bureau of Power and Light

LIGHTING RATE SCHEDULES are based upon the desirable high power-factor load characteristics of the incandescent lamp. As a protection against the possibility of rampant use of low-power-factor lighting devices, 90 per cent power factor has been stipulated by the utilities in the Log Angeles area.

The recent development of fluorescent lamps opened up tremendous illuminating fields for the gaseous discharge tube. In view of these developments it was felt that the power-factor-correction clause should be enforced in order to prevent a rise in the cost of supplying lighting loads.

Conventional Fluorescent Circuits

Such enforcement, however, led to tests being made with conventional fluorescent-lamp circuits corrected by the use of a static condenser connected across the line. These showed that the anticipated power-factor correction was not obtained.

Test data on the variation in circuit power factor obtained by applying variable amounts of across-the-line capacity to a 15-watt fluorescent lamp (operating in one case with a low-loss ballast reactor and in the other case with a high-loss reactor) showed that the power factor reaches a certain maximum and then decreases, going from lagging to leading without passing through unity. Maximums were 0.93 and 0.82 for a low-loss and high-loss type of auxiliary reactor respectively.

The inability fully to correct power factor by static capacity lies in the distorted wave shape of the current drawn from the line. The lamp current is considerably distorted due to the characteristics of the gaseous discharge and due to saturation in the ballast reactor. This in turn, due to voltage drop, distorts the voltage. The shape of the current drawn by the static condenser depends upon the shape of the voltage impressed upon it. The reactance of a condenser

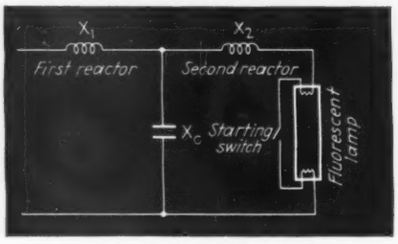


FIG. 1—SCHEMATIC DIAGRAM of T-type auxiliary for low-voltage fluorescent lamp

varies inversely with frequency, so any harmonic frequencies that may be present in the applied voltage are amplified in the condenser current. The combination is such that the current drawn from the line is very considerably distorted and does not give the power-factor correction expected from considerations of the fundamental frequency alone.

J. K. McNeely and R. R. Law presented a paper* in which they showed how the constant current circuit of Steinmetz could be applied to obtain unity power factor and excellent current-wave shape in neon-tube circuits. This circuit was applied to the low-voltage fluorescent lamp and in this application produced excellent power-factor and wave-form conditions.

The constant current circuit of Steinmetz consists of a "T" arrangement of two reactors and a capacitor as shown in Fig. 1. Theoretically, the best performance of this circuit obtains when the ohmic values of X_1, X_2 and X_c are equal, but if the circuit becomes energized without the lamp —a quite likely possibility—series resonance exists between X_1 and X_c, with attendant damaging currents and voltages. Fortunately, satisfactory performance of the T-type circuit is not critical to the values of the reactances, so it is possible considerably to offset resonance by proper selection of these reactor values and thereby make the circuit practical.

The performance (Fig. 2) of the T-type circuit with a 40-watt fluorescent lamp for a commercially good impressed voltage and for a badly distorted voltage gives in both cases practically unity power factor and very good current wave shapes.

Effects of Load Wave Form

The main basis for any insistence on improvement of the characteristics of the fluorescent lamp circuit rests on the effects of the present type of circuit on the power system. A study of such loads was made from the standpoint of supplying them through a distribution system and determining the resulting line drops, line losses, telephone influence effects, watt-hour meter inaccuracies and other miscellaneous effects as compared with normal sine wave conditions.

* "Unity Power Factor for Neon Signs," J. K. McNeely and R. R. Law, *Electrical Engineering*, Vol. 50, 1931.

Wave-Form Analysis—The harmonic content of the various waves is given in Table I.

Typical Feeder—A typical 5,000-volt lighting and commercial load feeder was assumed. Investigation indicated that the power factor of present normal loads at the customer's premises was approximately 0.9. All distribution was considered overhead and no line capacitance was included.

Load Assumptions—A normal feeder load was 1,870 kw. at the customer's premises. To show the effects of fluorescent-tube loads, it was assumed that 10 per cent and 25 per cent of the total load of 1,870 kw. on a feeder was made up of the fundamental of any of the three waves under consideration. The fundamental of these distorted waves was used at its proper power factor together with the various harmonics in their proper phase relation and magnitude. Thus a total of six different load distortion conditions were investigated.

Voltage Drop and Loss Calculations—The line current voltage drops were calculated and these were added to the phase-to-neutral voltage. The effective value of this voltage was determined and compared with the similar original sinusoidal voltage. The I^2R loss due to the flow of current with harmonic content was also calculated. The results of these calculations are set up for comparison in Table II.

It will be observed that by comparison with a normal voltage drop of 10.7 per cent, as found on the pure sine wave basis, the circuits having 10 or 25 per cent of their kilowatt load made up of wave form "A" would have to be derated to the values shown in the last column of Table II for waves "A" and "B." However, if sufficient condenser capacity is added to bring the power factor of the fundamental of the lamp current to unity, the resulting line drops are less than for the 90 per cent power factor normal sine wave condition, and the circuit capacity would be increased as shown for wave "C."

The copper losses only are included in the columns headed line loss. Incremental losses are the losses assigned to the fluorescent load expressed as a percentage of that load. It will be observed that with the condenser being used the losses are slightly reduced.

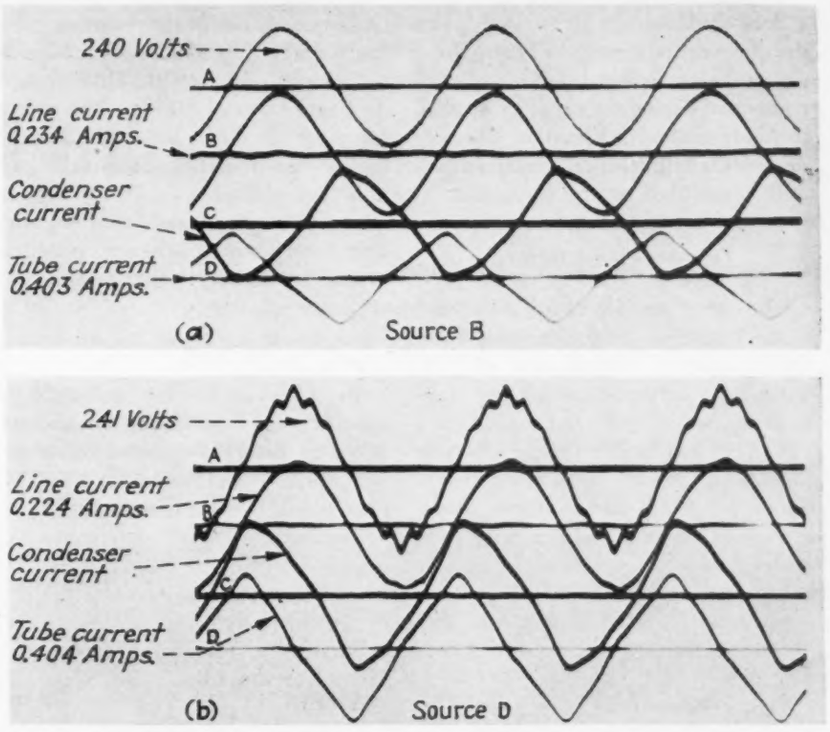


FIG. 2—OSCILLOGRAMS of currents in T-type fluorescent lamp circuits

(a) Good voltage wave form on G.E. 40-watt T-12 fluorescent tube with T-type auxiliary like Fig. 1:
X_1 = 40-watt thermal auxiliary
X_2 = 30-watt magnetic auxiliary
X_c = 4.67 μ f.
Combination gives line power factor = 1, TIF = 1.1, DF = 0.014.

(b) Jagged voltage on similar tube with T-type auxiliary but with elements (Fig. 1) as follows:
X_1 = 30-watt thermal auxiliary in parallel with 20-watt magnetic auxiliary; all in series with 40-watt magnetic auxiliary.
X_2 = 30-watt magnetic auxiliary.
X_c = 4.67 μ f.
Combination gives line power factor = 1.

Table I—Harmonic Content of Waves

Order of Harmonic		1	3	5	7	9	11	13	15	17
Wave	Designation	Per Cent of Harmonic in Terms of the Fundamental								
A	Tube current.....	100.00	23.94	5.53	2.86	1.53	0.05	0.34	0.82	0.08
B	Tube current.....	100.00	7.01	1.12	0.78	0.96	0.50	0.36	0.74	0.16
C	Tube and condenser.....	100.00	9.86	3.78	3.05	3.14	5.84	0.79	2.15	0.27

Table II—Voltage Drop and Losses

Fluorescent Lamps				Total Combined Load — 1,870 Kw.					
						Line Losses			
Wave Form	Per Cent of Total Load	Power Factor of Fundamental	R.m.s. Amp.	R.m.s. Amp.	Total Kw.	Per Cent	Incremental, Per Cent	Line Drop, Per Cent	Rating of System, Per Cent
Sine	..	.....	...	250	131	6.55	6.55	10.7	100.0
"A"	10	0.462	50	266	149	7.38	14.25	12.0	89.2
	25	0.462	125	297	185	8.99	15.65	14.2	75.3
"B"	10	0.579	39	260	142	7.01	11.4	11.5	93.0
	25	0.579	98	277	161	7.93	11.8	12.8	83.5
"C"	10	0.996	23	246	127	6.38	4.8	10.3	104.0
	25	0.996	57	242	123	6.15	2.9	9.8	109.2

It thus becomes evident that from a loss and voltage drop standpoint the uncorrected fluorescent lamp loads are undesirable, but that by sufficient corrective condenser capacity applied to the circuit with the more liberally designed auxiliaries the voltage drops and losses need not be increased.

Telephone Interference

The actual amount of noise induced in the telephone circuit depends upon the product of current and its TIF (telephone influence factor) for magnetic induction and upon the product of voltage and its TIF for electrostatic induction. Noise units were determined for 1,000 ft. exposures, along the main feeder. The open wire telephone circuit was assumed to be a balanced non-pole pair 8 ft. below the power conductors, untransposed, and grounded through the central office equipment.

Telephone engineers regard 100 noise units as being an undesirable amount of interference in city service, although values up to 200 noise units are tolerated in rural service.

The results pertaining to telephone interference are tabulated in Table III.

From them it will be observed that the use of the static condenser more than triples the value of TIF for the lamp circuit. If the entire 250 amp. of feeder load had been made up of fluorescent lamps with condenser correction the number of noise units induced per 1,000 ft. of exposure would have been 3,125.

In this study the reference was a pure sine wave and the normal system load was assumed to be of this character.

Since inductions in excess of 100 noise units are probably undesirable, it becomes evident that even such low percentages of this kind of load as 10 or 25 per cent become objectionable for exposures of 500 ft. The correction of the load by capacitors becomes particularly undesirable. If this type of load should ultimately replace present incandescent lighting the interference, without question, would be entirely impracticable.

Current Wave Form Specifications

In addition to the power-factor specification for lighting schedules it becomes desirable, therefore, to set up limits to the wave form of the currents drawn by such loads.

The harmonic frequency content of any wave is conveniently expressed by the distortion factor (DF). This is defined as the ratio of the effective value of all the harmonic frequencies present to the effective value of the total wave.

In current wave form specifications which have been tentatively proposed the TIF limit (Table IV) has been set at 50 and the DF limit has been set at 0.25. Since the wave shape of the line current of devices corrected by across-the-line condensers is influenced not only by the distortion introduced by the device itself but by the shape of the impressed voltage it is necessary to specify the characteristics of the voltage wave used when testing the current wave form of such devices.

The TIF values of commercial 60-cycle supply voltages naturally vary considerably between power systems and between points on any one power system. Anything below 10 would probably be considered a good voltage wave. The DF of commercial 60-cycle supply voltages is generally less than 0.01 and factors as high as 0.10 would be very rare.

In addition to the requirement of high power factor for loads served under lighting rate schedules a current wave form requirement is suggested, worded somewhat as follows:

> The current drawn by gaseous tube lighting equipment shall have a telephone influence factor not to exceed 50 and a distortion factor not to exceed 0.25 as determined by measurement when the device operates on a supply voltage which has a telephone influence factor not less than 10 and a distortion factor not to exceed 0.10.

This requirement is liberal and yet rigid enough so that it should stimulate the development of devices with good wave form.

The rule would allow the use of the average corrected-type neon or neon transformers as measurements indicate the TIF of these to be from 35 to 52 and the DF to average 0.20. For the low-voltage fluorescent lamps the rule would allow the use of the Tu-lamp, or twin auxiliary, which has a TIF between 25 and 30 and a DF in the neighborhood of 0.20. Adherence to the rule would prevent the use of single lamp circuits, power-factor corrected with across-the-line condensers, as the TIF of these circuits is generally well above 50.

Although the average customer for whom these rules are established has difficulty understanding the meaning of such technical rules, the manufacturer can understand the situation, and it is with this idea that it has been suggested.

The ideal way for realization of the goal of high power factor, good wave form lighting equipment is to have such a degree of co-operation that the consumer can't get any device that doesn't fill the requirements.

Table III—Telephone Interference

Fluorescent Lamps			Total Combined Load					
			Current			Voltage		
Wave Form	Per Cent of Total Load	TIF	R.m.s. Amp.	TIF	Noise Units per 1,000 Ft.	TIF	Noise Units per 1,000 Ft.	Total Noise Units per 1,000 Ft.
Sine	..	...	250	1	15	1	1	15
"A"	10	66	266	12	196	18	9	196
	25	66	297	28	492	44	23	492
"B"	10	61	260	9	141	14	7	141
	25	61	277	22	352	34	18	352
"C"	10	212	246	20	285	25	13	285
	25	212	242	50	714	64	32	714

Table IV—TIF of Various Single Frequencies

Frequency	TIF	Frequency	TIF	Frequency	TIF
60	1	900	7,270	1,740	3,660
180	15	1,020	11,600	1,800	3,580
300	205	1,080	11,980	1,860	3,570
360	370	1,140	11,100	1,980	3,500
420	590	1,260	7,920	2,100	3,500
540	1,250	1,380	5,470	2,500	3,680
660	2,250	1,440	4,740	3,000	3,940
720	2,990	1,500	4,400	5,000	480
780	4,080	1,620	3,900	1,070 (Peak)	12,000

Transformer Characteristics Affect Distribution Design

The control of transitory voltage dips appears to call for transformers with higher core loss, lower copper loss, lower reactance and lower resistance

H. A. HOLMES,* Monongahela West Penn Public Service Company, Fairmont, W. Va.

MOST distribution voltage problems are calculated on a steady-state basis, usually by considering the effects of certain maximum diversified demands being applied at their respective locations through various sizes of conductors. The drops in secondaries, transformers and primaries are held at definite limits. Drops sometimes suggested are 2 per cent primary, 3-4 per cent transformer, 2-3 per cent secondary. The lower secondary drop is usually initial and the 3 per cent the ultimate. Where feeder regulators are used they may be set to compensate for primary drop at the load center, but rarely compensate for any of the secondary drop. In compensating for transformer drop, it is usually done by setting the base voltage from 2 per cent to 4 per cent higher than the nominal voltage and not by adding resistance and reactance to the compensator setting.

Flicker is then usually dealt with on a complaint basis and correction made when complaints are severe enough to make such a step necessary. Accepted means of reducing flicker include secondary banking, auto-transformers at proper locations on the secondary, relocation of transformers, and possibly change to a larger transformer.

This policy in dealing with flicker makes each problem a special one, requiring investigation and an engineering solution. It would seem that there are enough of such type of problems arising in connection with older installations that they should not be increased by failure to consider the possibilities of such trouble when making a new installation.

Unless some fairly large power load is to be supplied from a large transformer supplying lighting for a considerable area, the flicker problem is usually confined to installations of smaller transformers, 5 kva. and under, with small loads distributed over some distance. It is questionable whether the part that the transformer itself plays in this problem has been fully appreciated. Regulator action is too slow to overcome flicker and therefore may be

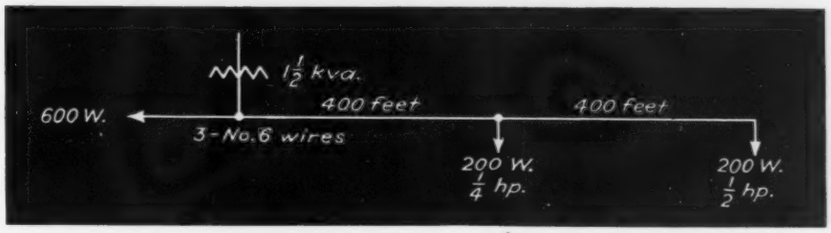


FIG 1—TYPICAL half-secondary adequate for steady-state load, but transformer dip is principal source of flicker on motor starting

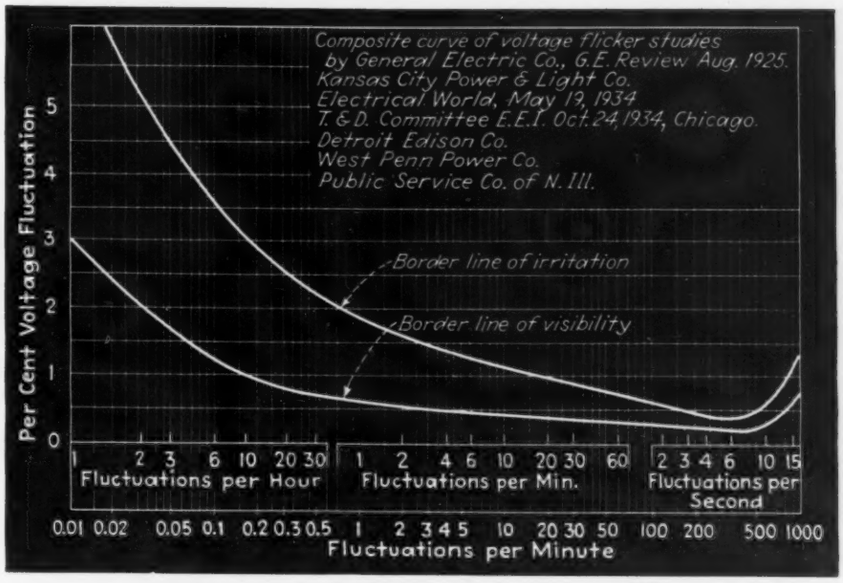

Composite curve of voltage flicker studies
by General Electric Co., G.E. Review Aug. 1925.
Kansas City Power & Light Co.
Electrical World, May 19, 1934
T. & D. Committee E.E.I. Oct. 24 1934, Chicago.
Detroit Edison Co.
West Penn Power Co.
Public Service Co. of N. Ill.
Border line of irritation
Border line of visibility
Per Cent Voltage Fluctuation
0
1
2
3
4
5
1 2 3 6 10 20 30
Fluctuations per Hour
1 2 4 6 10 20 30 60
Fluctuations per Min.
2 3 4 6 10 15
Fluctuations per Second
0.01 0.02 0.05 0.1 0.2 0.3 0.5 1 2 3 4 5 10 20 30 50 100 200 500 1000
Fluctuations per Minute

FIG. 2—RELATIONS of voltage fluctuation to frequency of their occurrence
Composite curve from voltage flicker studies by General Electric Company. Based on data in *G. E. Review* (August, 1925), in "Electrical World" (May 19, 1934), of the E.E.I. T & D committee (October 24, 1934, Chicago) and of the following utilities: Kansas City Power & Light Company, Detroit Edison Company, West Penn Power Company and Public Service Company of Northern Illinois.

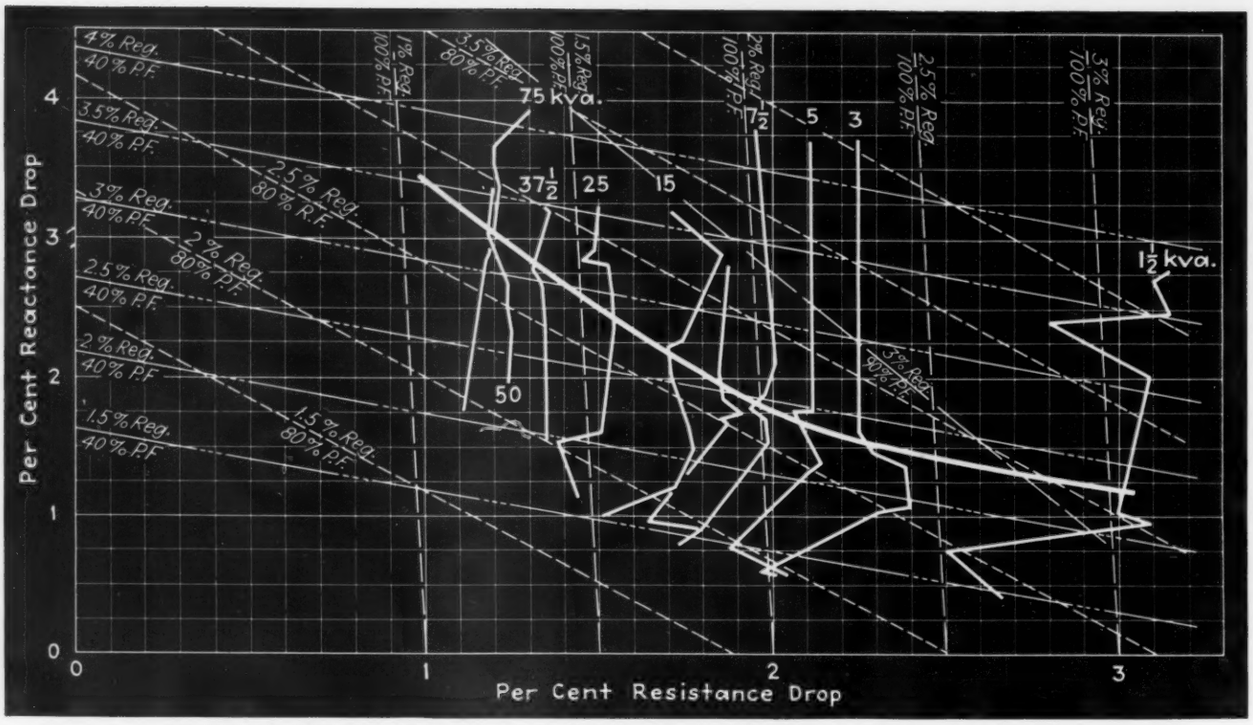


FIG. 3—DISTRIBUTION TRANSFORMERS plotted in terms of regulation, reactance and resistance. Regulation determinable for rated load at power factors of 0.40, 0.80, 0.90, 1.0 from per cent reactance and resistance drops of the particular transformer

eliminated from the discussion.

As we are concerned with small distributed loads, let us take a typical small transformer with half its secondary system (Fig. 1). For steady-state conditions we would probably assume the ½-hp. motor running. Load would also be assumed as being served at 230 volts. Reactance of the secondaries would be neglected. No. 6 wire gives 0.00353 volt, or 0.001534 per cent drop, at 230 volts per 1,000 watt feet. The assumed load totals 600,000 watt feet and the drop would be 0.92 per cent, well within the allowable 2 per cent initial drop. The total load is 1,450 watts and the power factor should be above 80 per cent, so that a transformer with 3.3 per cent drop at 80 per cent power factor would have $\frac{1,450}{1,500} \times 3.3$ per cent, or 3.2 per cent drop through it. The transformer would be loaded 96.7 per cent. These values all check conservatively. Such an installation might easily be passed for construction.

Motor Starting

Let us now analyze the starting conditions for the ½-hp. motor. The transformer selected might well have an *IR* drop of 3.09 per cent and an *IX* drop of 2.0 per cent. The No. 6 secondaries have an *IR* drop of $\frac{1,500 \times 0.81 \times 0.8 \times 100}{230 \times 230} = 1.83$ per cent for full transformer load and an *IX* drop of $\frac{0.111}{0.81} \times 1.83 =$ 0.25 per cent. The ½-hp. motor is a split-phase motor instead of the more modern capacitor type with a starting current of 15 amp. at 40 per cent power factor. Neglecting the quadratic portion of the regulation formula our drop due to starting is:

$$\frac{15 \times 230}{1,500}\left[\begin{matrix}0.4\ (3.09 + 1.83 + \\ 0.916\ (2.0 + 0.25\end{matrix}\right.$$

$$= 2.3\ (1.968 + 2.06)$$
$$= 2.3 \times 4.028 = 9.25 \text{ per cent}$$

This would undoubtedly cause objectionable flicker, yet the steady-state analysis looked unusually good.

Of this drop, we have in the transformer,

$$\frac{15 \times 230}{1,500}\ (3.09 \times 0.4 + 2.0 \times 0.916)$$

$$= 2.3\ (1.236 + 1.832) = 2.3 \times 3.068$$
$$= 7.06 \text{ per cent}$$

and in the line,

$$\frac{15 \times 230}{1,500}(1.83 \times 0.4 + 0.25 \times 0.916)$$

$$= 2.3\ (0.732 + 0.229) = 2.3 \times 0.961$$
$$= 2.21 \text{ per cent}$$

This indicates immediately that the steady state conditions are not the ones governing a satisfactory design for these conditions. A ¼-hp., 115-volt split-phase motor at the same location would produce similar disturbances and would probably start more frequently.

Transformer Regulation

The tolerance of voltage fluctuation has been the subject of many discussions and a composite curve of seven determinations has been published by the General Electric Company. For four fluctuations per hour, this curve (Fig. 2) gives about 4.2 per cent as the limit of tolerance. If the line itself takes 2.2 per cent, then the transformer can only have 2 per cent. As 15 amp. load represents 230 per cent load on a 1.5-kva. transformer, the transformer can only have $\frac{2.0}{2.3}$ or 0.87 per cent drop at full load.

To study the regulation characteristics of transformers a chart with per cent reactance plotted as ordinates and per cent resistance as abcissas is most convenient. In Fig. 3 a number of commercial transformers have been analyzed by this means. This chart includes some transformers more than ten years old and others as recent as 1½ years ago. On this chart you will see three sets of parallel diagonal lines which enable one to determine the regulation of the

transformer for any combination of resistance and reactance. The formula for regulation is:

$$\text{Regulation} = \frac{IR}{E}\cos\theta + \frac{IX}{E}\sin\theta + \tfrac{1}{2}\left(\frac{IX}{E}\cos\theta - \frac{IR}{E}\sin\theta\right)^2$$

The quadratic portion of this equation has little influence for values usually encountered and may be dropped. $\frac{IR}{E}$ and $\frac{IX}{E}$ are respectively the resistance and reactive drops expressed as decimals. Let $R_T = \frac{IR}{E}$ and $X_T = \frac{IX}{E}$ where R_T and X_T are the per cent drops specified by the transformer manufacturer, and we have:

$$\text{Regulation} = R_T\cos\theta + X_T\sin\theta,$$

which, for any specified power factor, Cos θ, is a straight line formula. To plot on the chart, the value of regulation is assumed—say 3 per cent, and power factor at 80 per cent. Sin θ then = 40 per cent and

$$3 = 0.8\,R_T + 0.4\,X_T.$$

Two points only need to be determined and connected by a straight line. The process is repeated for other values of regulation and power factor desired.

From this chart we see that there are no transformers in the 1½-kva. size with less than 1.5 per cent regulation at 40 per cent power factor. We are, therefore, forced to a 3-kva. size and the allowable regulation becomes $\frac{15 \times 230}{3{,}000} \times 2.0$, or 2.3 per cent. The chart lists at least six transformers having 2.3 per cent regulation or less. For convenient use this chart should have a symbol at each point designating the make and type of transformer listed, so that the distribution designer may specify the exact transformers which may be used.

The alternative is to install a second transformer at the ½-hp. motor and probably move the one shown closer to the other end of the secondary. This would permit a 1½-kva. transformer with 1.6 per cent regulation to be used. Although the chart shows two such transformers, only one is available now at the usual prices. Such an installation would be the more expensive solution, as two 1½-kva, transformer installations will cost more than one 3-kva. installation, even though 400 ft. of secondaries could be eliminated.

This chart can be used for any number of purposes where transformer regulation must be determined quickly or a transformer selected to meet certain regulation requirements.

If motors of the more modern capacitor type were to be considered, the 80 per cent power-factor curves or possibly a 90 per cent power-factor curve should be used.

Loss Ratio

This brings us to the next portion of our problem. If regulation is to be reduced for capacitor motor starting, we can see two possibilities—resistance as well as reactance. Most of the 3-kva. transformers show a resistance drop of from 2.25 to 2.4 per cent with reactance drops from 3.7 per cent to 1 per cent. With R_T = 2.25 per cent, a change in X_T from 3.7 per cent to 1 per cent drops the regulation at 80 per cent power factor from 4.1 per cent to 2.4 per cent. If we take the next step in the 3-kva. series we drop R_T to 1.96 per cent and X_T to 0.6 per cent and the regulation to 1.9 per cent. It happens that this particular transformer did not show an increase in iron loss when the resistance was decreased. It was, therefore, probably a more expensive transformer to build than the others charted, although that was not reflected in its price. If we are to consider such revised characteristics, it is obvious that all manufacturers could not make a similar change without reducing their profit or charging more for the transformer.

How necessary is it that iron loss

[*Continued on page 96*]

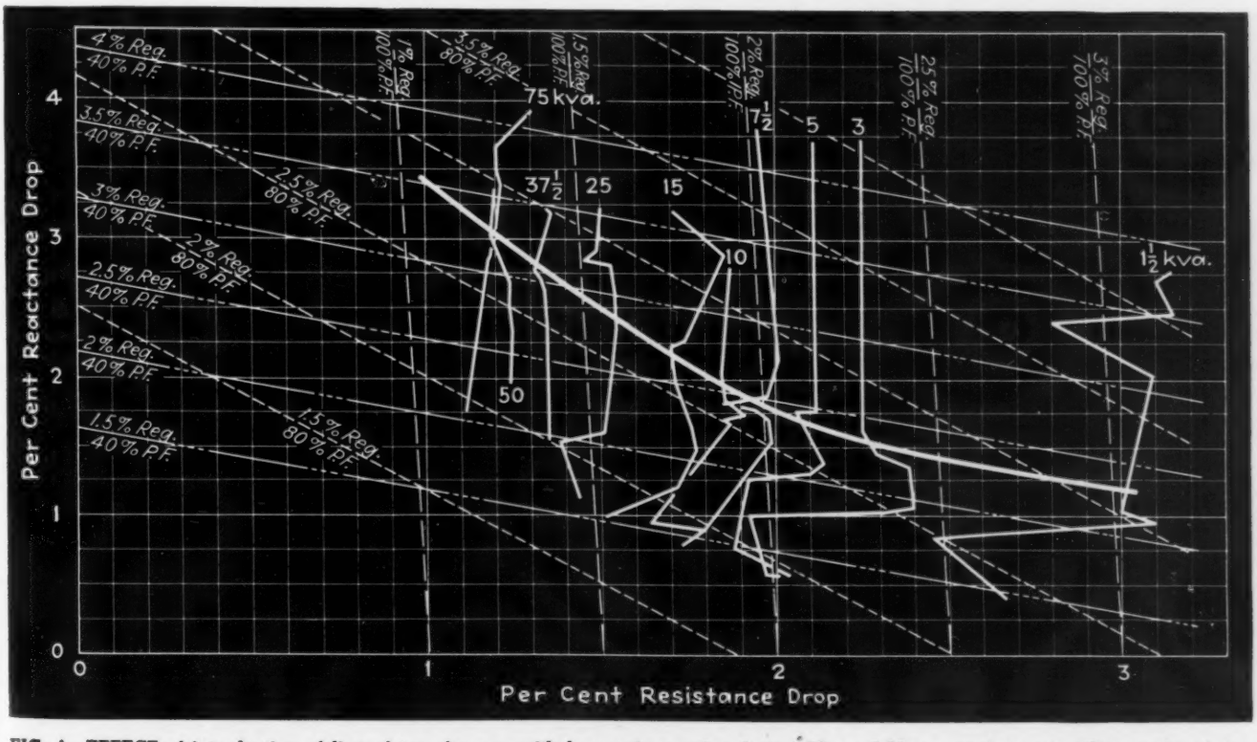


FIG. 4—EFFECT of introduction of line of transformers with loss ratio ranging from 1.68 to 2.61 as against prevailing ratio of 3

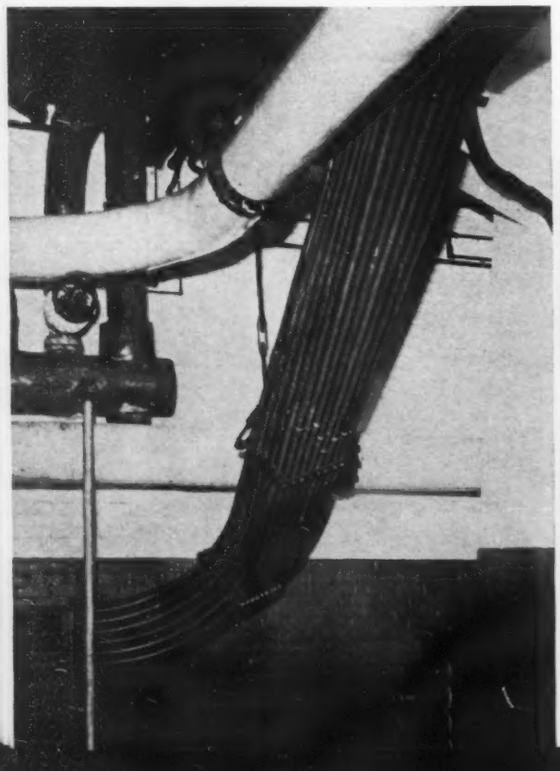
THE MUNICIPAL PLANT undergoes progressive modernization—Rocky Mount, N. C., may use the brick from the unused stack at the left to build a garage as part of program of station modernization involving a recent superposition

Flexible Topping Turbine Doubles Plant Capacity

Rocky Mount adds unit of 10,000 kw. capacity at superposition pressure and capable of 7,500 kw. at existing boiler pressure — Desuperheating problem solved

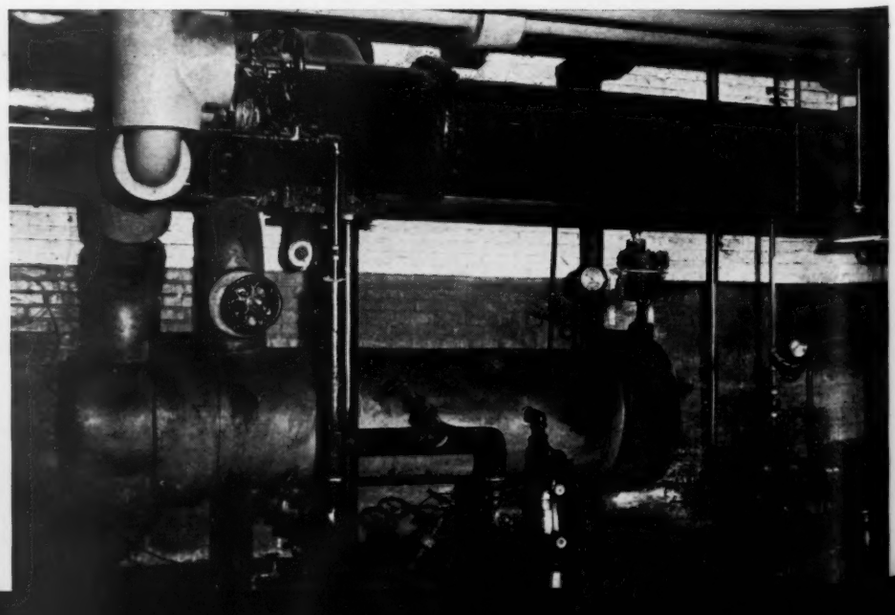
G. P. WOMBLE, General Manager Public Utilities of Rocky Mount, N. C.

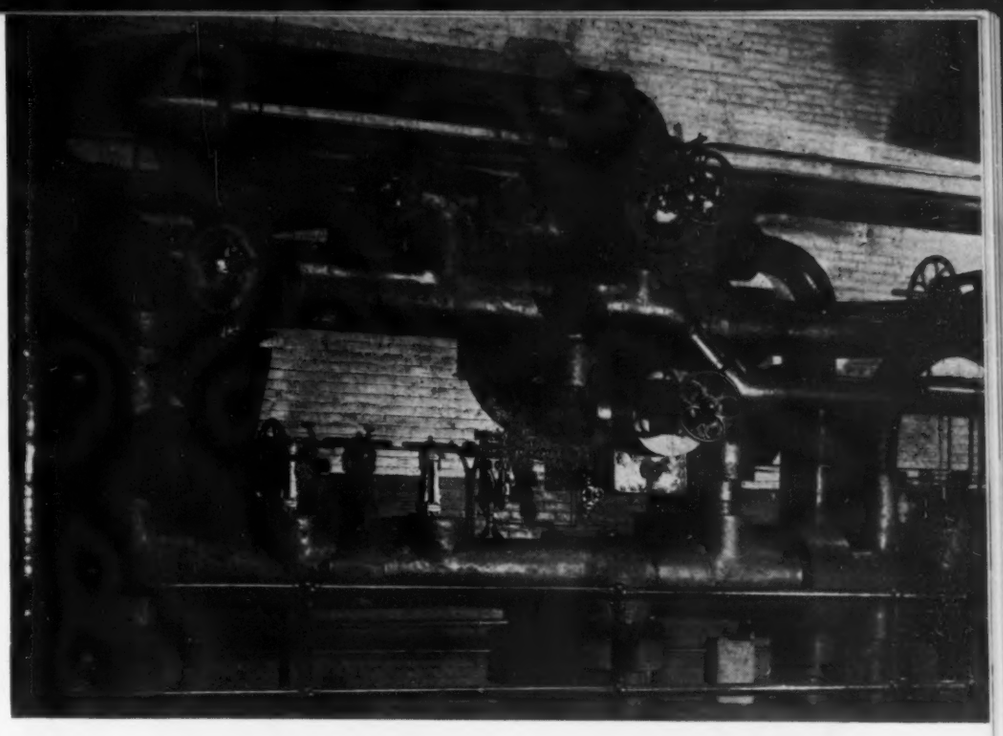
IN NEED of additional capacity to anticipate expected loads, the city of Rocky Mount decided (1) to double the capacity of the 7,500-kw. plant, (2) to superpose a 450-lb., 700 F. turbine on the two 250-lb. 525 F. machines, (3) to obtain a unit capable of operating efficiently and successfully at either 450 or 250 lb., (4) to adhere to stoker firing, (5) to adopt 11 kv. as the voltage of the new machine and (6) to buy a 3,600-



CONDUIT for generator control cables. Angle rise to cross the aisle en route to panel on right gallery at same level as row of turbines (left)

FEEDWATER stage heater extracts at third stage of turbine to raise feedwater to 330 F.





REDUCING VALVES and desuperheater lower pressure and temperature from new boiler (450 psi., 700 F.) to 250 psi. and 550 F. so that the new unit or either or both off the two older ones can operate simultaneously from the new boiler

r.p.m. machine. The new unit has now been operating one year and has consistently exceeded the guaranteed performance.

Coal consumption per kilowatt-hour has been reduced from an average of 1.75 to 1.25, with a one-day low of 1.14 lb.

Pressure

One of the first things to be settled was the matter of boiler and turbine pressure and the question of a condensing or superposed unit. The possibility of obtaining a General Electric unit which could carry the necessary increment of load at 250 lb. but still be able to handle an increased load at the 450-lb. superposition pressure was a deciding factor. The new unit will carry about 10,000 kw. under overload conditions when supplied directly from the new 450-lb. boiler.

A point of interest about the turbine is the automatic steam seal control for high and low pressure at the glands.

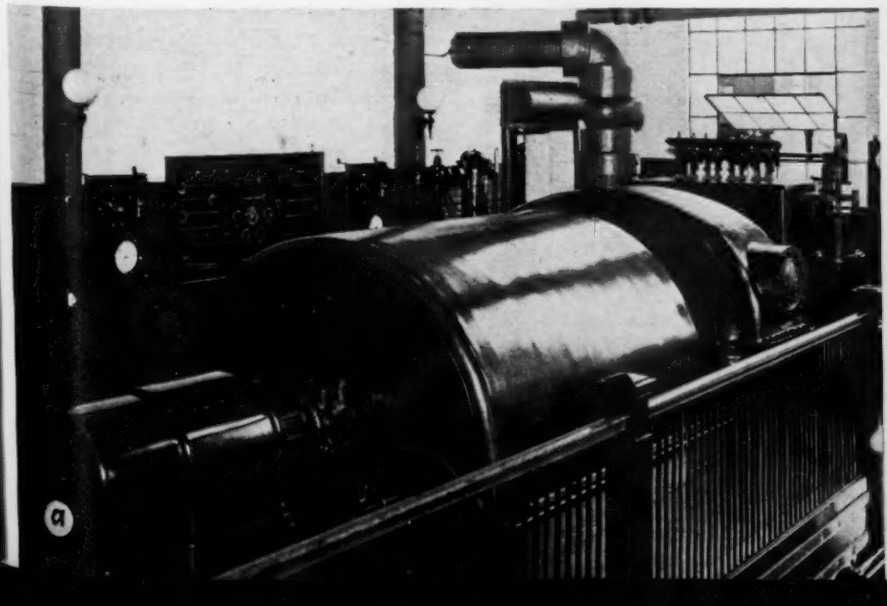
To protect the blades in the two existing 250-lb. turbines against blade erosion at the higher steam temperature generated by the new Babcock & Wilcox boiler, desuperheating equipment was installed to reduce the superheat from 700 F. to about 550 F., while reducing valves lower the pressure from 450 to 250 lb.

The boiler is equipped with clinker grinder and Reeves variable-speed drive for the Riley stoker. The boiler feedwater stage heater operates at 70 lb. pressure fed from the third stage of the 7,500-kw. turbine and raises the feedwater temperature from 220 to 330 F. Evaporation is at about 10 lb. of water per pound of coal and approximately 10 per cent of make-up feedwater is required.

Recording equipment has been provided in the station for bearing oil temperature, turbine exhaust vacuum and the temperature of cooling air circulated to the generator.

NEW 7,500-kw. unit (at 250 psi.) carries 10,000 kw. at 450 psi. superposition

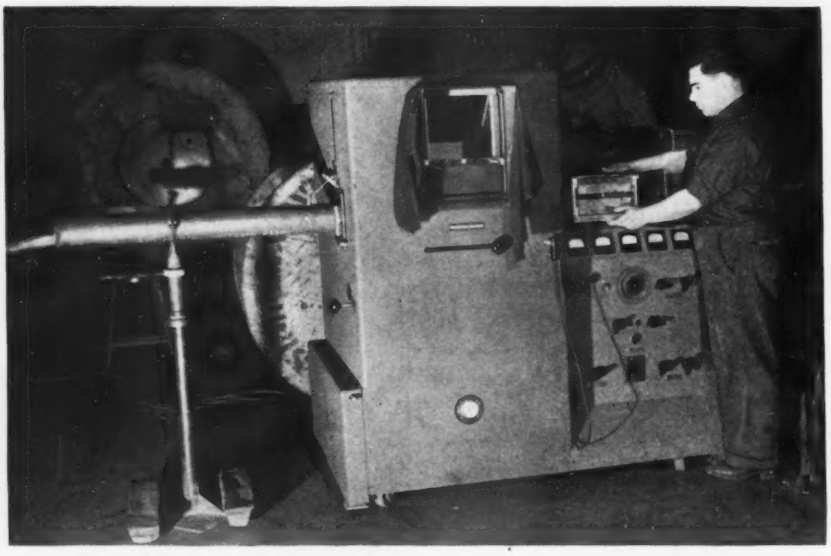
(a) Unit mounted longitudinally with two previous units totaling 7,500 kw. (b) It is at far end of gallery. Stairway shown can be removed to make room on lower floor level for lowered stator or rotor of either turbine or generator. Note routing of control ducts.



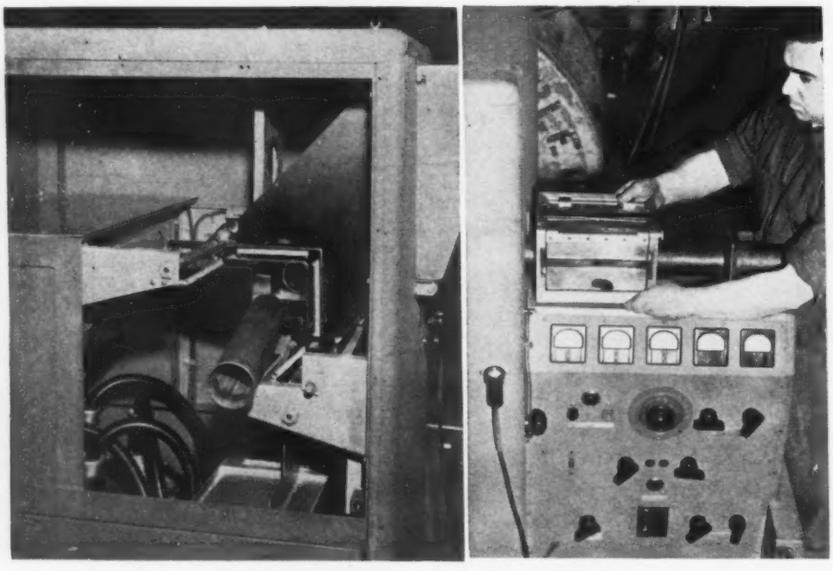
X-Ray Cable Inspection

Design and inspection of wire and cable insulation aided by new equipment — Visual and photographic scrutiny for defects available

*E. W. DAVIS, G. J. CROWDES, E. E. MERKEL and VICTOR HICKS**



ASSEMBLED X-ray cabinet in cable factory; inspection aperture in upper center



INTERIOR VIEW of cabinet with side removed (left). Close-up of cable entering X-ray cabinet through shielding tube (right)

In the view at left, two images taken at right angles appear sidewise in a vertical plane to provide complete scrutiny of interior cable conditions when the equipped unit is in use.

COMPLETE KNOWLEDGE of the properties of the insulating materials used in the manufacture of insulated wire and cable is essential to proper design and production, and beyond this, it is important that the processes of manufacture shall not introduce undesirable features of either an electrical or mechanical nature into the product. For many years manufacturers have relied almost exclusively upon various physical and electrical tests to prove the suitability of cable lengths for service. Such tests are designed to show primarily (1) that the quality of insulating material is up to standard, and (2) that the mechanical application is such as to produce no faulty places.

Tests heretofore used have been (a) physical: such as tensile, elongation, accelerated aging and chemical analysis; (b) mechanical: dimensions on ends of sections, diameters and visual inspection of outside surfaces and dissections, and (c) electrical: high potential, insulation resistance, capacitance, power factor, ionization and life tests.

Such tests over a period of years have been developed to give a high degree of reliability and with some types of cable are sufficient. Laminated structures such as impregnated paper and varnished cambric cable are best suited for check-ups by these tests. Insulations of a plastic or solid nature present other manufacturing problems and there have been (particularly with high-voltage cable) indications that some further test procedure would be of advantage to supplement that now available.

Chief among the problems in insu-

* Mr. Davis, chief, and Mr. Crowdes, assistant, electrical engineer, Simplex Wire & Cable Company; Mr. Merkel, development engineer, and Mr. Hicks, industrial X-ray engineer, Westinghouse X-Ray Company, Inc.

lating rubber and other solid dielectrics is that of maintaining concentricity, roundness and close adhesion of insulation to conductor and shields if used. Concentricity is obviously necessary in order to keep the minimum thickness of insulation in excess of that allowed by specifications. This problem becomes more difficult with larger and heavier conductors and thicker walls of insulation. Since rubber and rubber-like insulations have obvious advantages, they are being used more and more in the higher voltage field, and the problem is a pertinent one.

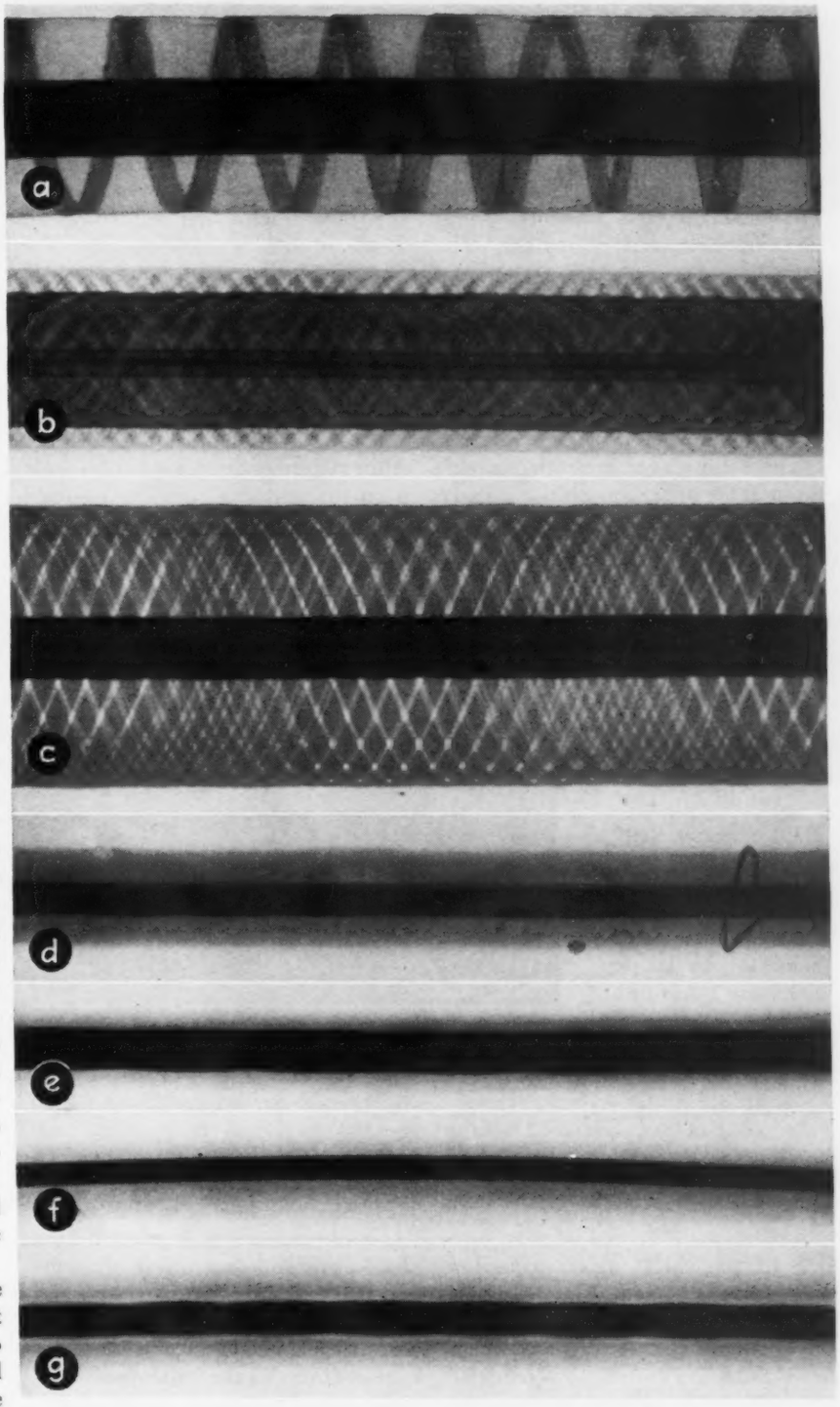
Various Inspection Methods

Various methods have been investigated for such examination of cable. Electromagnetic and electrostatic methods have possibilities, but have not so far been developed to a point of practical value. Fluoroscopic X-ray examination, however, serves as an adequate and economical means of continuous inspection of cable lengths. In addition, as a laboratory tool, it can be used to advantage to study processes, materials and various cable designs. X-ray examination in a single plane is insufficient for complete study, and since the form and size of sample or length studied do not lend themselves easily to rotation, two beams are necessary. It is desirable that the medians of these beams and cable be orthogonal, although other non-coplanar systems of directions may serve. A system of mirrors to project two images into one opertor's view is desirable.

Such apparatus has been developed and successfully applied in practice and is described in this paper.

X-ray tubes are required which are capable of continuous operation at 10 milliamperes and 90 kv. peak to permit inspection of cables several inches in diameter, except where these are covered with heavy metallic sheaths, or where the insulation contains heavy metallic compounds. These would require equipment of a somewhat greater capacity. When permanent records are required, such tubes also serve for instantaneous radiography. Apparatus which is transportable and adjustable as to height is desirable for manufacturing reasons, and this has been attained in the design illustrated.

The X-ray tubes are conventional type, contained in two oil-filled and



X-RAY VIEWS of various cable insulations and conductors

(a) Single-conductor, No. 00, 19-strand, 19/64-in. wall Anhydrex AA-60 and 3-mil copper shielding tape at 89 kv., 10 m.a., five seconds.

(b) Single-conductor, double-shielded test lead, with concentric inner conductor and two braided shields at 89 kv., 10 m.a., ten seconds.

(c) Concentric shielded X-ray cable for 100 kv., with varnished cambric insulation, braided copper shield and outer rubber jacket, at 89 kv., 10 m.a., 7 seconds.

(d) Single-conductor, No. 1, 133 strands, 14/64-in. wall insulation. Illustrating voids in insulation adjacent to conductor. Rejected. Taken at 80 kv., 5 m.a., five seconds.

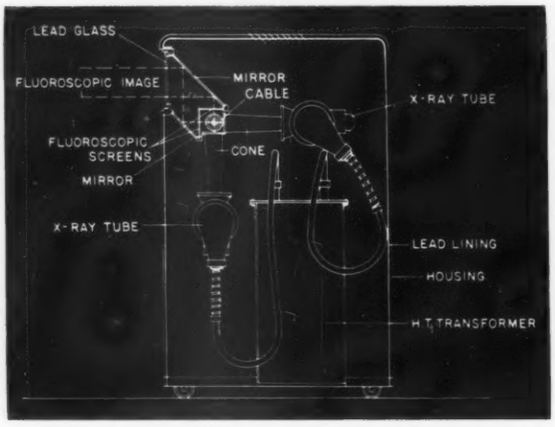
(e) Single-conductor, No. 6 strand, 10/64-in. wall, 30 per cent high gravity compound. Taken at 89 kv., 5 m.a., five seconds.

(f) No. 8 solid 12/64-in. wall, high-voltage rubber. Illustrating wave in conductor resulting in rejection due to thin insulation at one point. Taken at 80 kv., 4 m.a., five seconds.

(g) Single-conductor, No. 6, 7-strand, 10/64-in. wall corona-resistant compound, illustrating insulation not in intimate contact with conductor. Material rejected. Taken at 80 kv., 5 m.a., five seconds.

lead-covered housings and water-cooled. One X-ray beam is directed vertically upward and the other horizontally forward. Lead-lined apertures limit the beams to the areas of the fluoroscopic screens. The X-ray tubes are energized from one oil-immersed single-phase transformer with a center-grounded secondary. The high-tension connections from the transformer to the tubes are made by means of cables with grounded external metal webbing. The circuit is such that the tubes are electrically 180 deg. out of phase, thus avoiding "inverse" or unused voltages.

The cable under inspection passes through the apparatus on two pulleys which are adjustable in position so that any size of cable, within limits, may be made to have its axis pass through the intersection of the median X-ray beams. Each of the two fluoroscopic screens is perpendicular to the median X-ray beam from the corresponding tube. Two true projections of the cable, each magnified by approximately 10 to 15 per cent, are thus obtained. Two approximately parallel mirrors, inclined at about 45 deg. to the screens, are provided so that the operator, looking horizontally into the viewing aperture, sees these two projections side by side in a vertical plane.



SCHEME of X-ray tube, mirror and cable arrangement inside cabinet

A permanent record of any portion of the cable under inspection may be made without delay. In order to obtain the two X-ray projections on a single film, a cassette which bends the film into two perpendicular planes has been adopted. The cassette slides firmly into the frame, which also holds the fluoroscopic screen, and remains outside the X-ray beam during fluoroscopic examination. This frame is mounted on rollers running on a pair of rails. Pulling a trip cord allows the carriage to ride from the fluoroscopic into the radiographic position, actuated by a spring; the return is manual.

The control board contains knobs for adjusting the X-ray tube voltage in steps of 1 kv. in the working range, the voltage being indicated by two illuminated dials. The current passing through each X-ray tube is adjustable for fluoroscopy or radiography independently by means of induction regulators, milliammeters and filament current meters. An adjustable timer, operated by a push button, controls the radiographic exposures over a range of 0.2 to 14.0 seconds. The fluoroscopic controls are operable only when the screen and cassette carriage is in the fluoroscopic position; the radiographic controls, only when the radiographic position is employed; the apparatus is inoperable when in an intermediate position. After returning from the fluoroscopic position, operation can be resumed only by pressing the starting button. Suitable devices are employed so that the apparatus may be operated only under conditions of electrical safety.

Assemblage of the elements is supported by a welded steel framework. The entire apparatus is covered by a sheet metal housing which, with the exception of the control board and the viewing aperture, incorporates lead of adequate thickness for protection from X-rays employed. Lead glass is used both over the fluoroscopic screens and in viewing aperture. Casters suitable for shop transportation are employed. Four screw-jacks, driven by two hand cranks, provide adjustments for various work-bench heights within limits.

Operating Experience

The apparatus described above has been in more or less continuous operation for a period of months with satisfactory results. So far operation has been by technically trained personnel, but routine examination by less skilled personnel is contemplated. During the period of operation all precautions are taken by operators to eliminate exposure to stray rays, if any, and all operators are required to wear dental films which are developed periodically. So far there has been no evidence of exposure at all.

Inspection Procedure

In the period in use to date more than 200 types and kinds of cable have been examined and more than 600,000 ft. of cable has passed through for viewing. A great number of radiographs have been taken of places of interest in the cables examined.

In practice the cable to be viewed is placed on a "pay-off" reel in back of the X-ray machine. The cable passes through the machine, is viewed and reeled slowly onto a "take-up" in the front. Both ends are measured for thickness of insulation and concentricity. Concentricity, flatness, adhesion, voids, foreign particles, closeness of shielding and any other points pertinent to the cable under test are carefully noted. Specification tolerances as to insulation thickness are rigidly followed. They are:

Nominal Thickness of Insulation	Minimum Thickness of Insulation
Up to 4/64 in.	95 per cent of nominal
Over 4/64 in.	90 per cent of nominal

Radiographs are taken of places of interest or for record. In addition to lengths of cable, molded potheads, molded assemblies such as fever pads, etc., can be viewed as a final check on conductor or electrode position in the molded material and for proper assembling, open circuits, soldering and many other features. Continued experience has developed a fluoroscopic and radiographic technique for various grades of insulation, thicknesses and outer covers.

Thus has been successfully developed and used a bi-polar X-ray apparatus to allow the viewing and photographing of insulated wire and cable. This machine has been in use for about five months and has proved quite successful as a tool for studying and inspecting insulated conductors. Suitable technique for viewing and photographing has been developed and further experience should broaden the use of this powerful tool, and its early use as a specification auxiliary is forecast.

Man-Power Maintenance

Organized program of employee improvement results in high ratio of promotion within company personnel — Intensive job analysis and periodical rating of the individual employees are large factors

Gen. H. G. WINSOR,* Puget Sound Power & Light Company

IN ONE recent year, and not an exceptional year, one out of every eight employees of the Puget Sound Power & Light Company was promoted to a better job. There may be other electric utilities that can show a higher ratio of promotion within the organization; we have no industry statistics on this point. But even without figures for comparison we feel that our company's record of preparing employees for added responsibilities is something of which to be proud. The importance of this is emphasized by the effort now being made by the Council of National Defense through its nation-wide training and upgrading program.

Man-power maintenance is as necessary a matter as system maintenance if an electric utility is to perform adequately its function of public service. Recognizing the truth of this statement, P.S.P.&L. has consistently and continuously pursued a program of employee improvement for many years.

Fit Men to Jobs

The plan of "man-power maintenance" begins before actual employment, by obtaining more historical data concerning the applicant than is commonly thought necessary. This company compiles as comprehensive a history record on a rank and file employee as many a company considers required only in the case of a supervisor, all in the interest of obtaining new blood that will react to proper development methods. An employee is regarded as being on a temporary basis of employment during the first twelve months.

Job analysis development has been extended to a point where all of the various types of work are covered in a total of 394 classifications. This makes possible as concise a fitting of man power to jobs as is humanly possible.

The progress record maintained for each employee is dated from the day he or she is put on the payroll, and this report, coupled with the history record compiled of previous activities, presents a clearcut picture of the employee as an individual. Any changes in status, wage changes, promotions or demotions, any and all reports presented as a matter of routine, including physical examination reports, etc., are included in the progress report envelope, and in addition to these tangibles there are numerous intangibles which are considered to be of co-importance—attitudes toward fellow workers and toward employer, domestic problems, if any, and a careful record of all efforts toward self-improvement, whether sponsored by the company or not.

Self-Training, Mostly

Educational development is largely in the hands of committees of employees and, logically, active work on such committees constitutes a merit, as does any type of participation in educational work. Here are some of the committees on which employees willingly accept active assignments:

Customers' Service Committee—The work of this committee, as its name suggests, has to do with problems of improving employee-customer relationships.

Personal Development—This group has sponsored many types of self-improvement classes, including instruction in elementary and advanced electricity, public speaking, improved English, electrical cookery, "Know-Your-Company" sessions, and others.

And Fun, Too

Recreation—Sponsorship and direction of sports, competitive and otherwise, are in the hands of this committee of employees, as well as such interests as glee club, social affairs, picnics, fishing derby, skating parties, trips to ski bowl, theater parties, etc.

Safety Committee — The safety committee in each division and district holds regular meetings. Semi-annual accident prevention conferences are also held throughout the company under the direction of the personnel office, and a year-round accident prevention contest is company-wide. It is noteworthy that of the total 3,000 in the company 1,700 employees have voluntarily qualified for Red Cross Life Saving Certificates, and a number have progressed to the status of instructor.

Welfare Committee — Consideration for employees and their families in times of need is accomplished through the workings of this group.

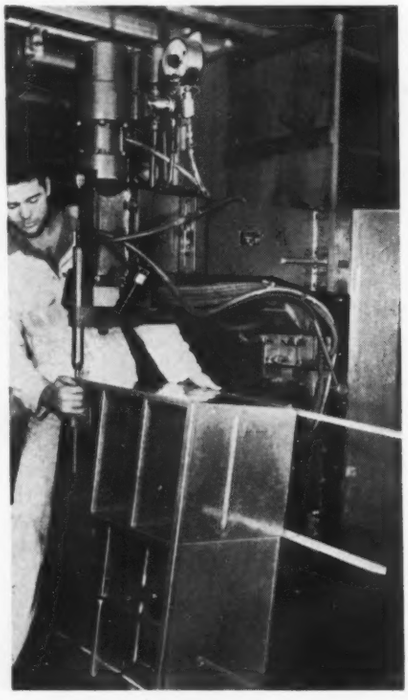
Women's Committee—Women employees, comprising approximately 10 per cent of the total, have an active organization in all districts. They consistently follow an educational program, and to a great extent parallel the work of the various other committees as they relate specifically

[*Continued on page 95*]

*Personnel officer.

Spot Welder Uses Magnetic Storage

Rectified three-phase supply charges reactor from which energy is released to the welding circuit — Scheme removes much of the flicker difficulty from resistance welding



Sciaky welder in operation

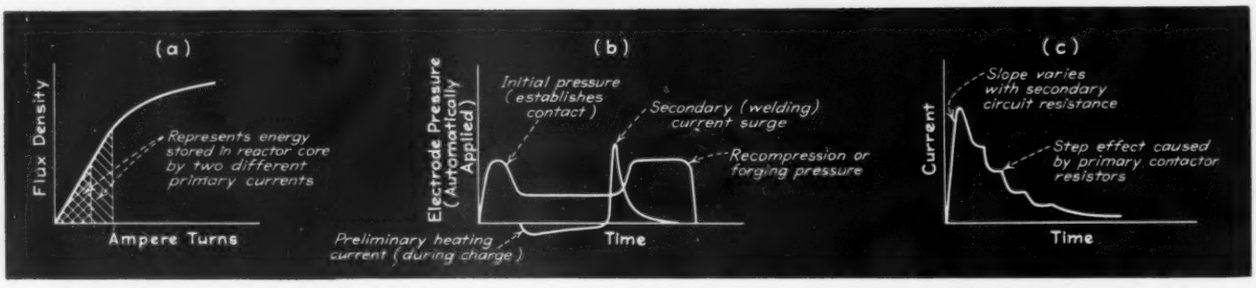
FUNDAMENTAL principle underlying operation of a new spot welder for aluminum, introduced in this country a year ago by the Sciaky Corporation, Chicago, involves the momentary storage of energy in an iron-core transformer-reactor and the release of that energy as an instantaneous heavy current surge in a low-resistance secondary path.

In this welder, which has attracted wide attention because of its favorable flicker performance, a mercury-arc rectifier served by a 40-kva., three-phase transformer supplies direct current at 110 volts to the primary winding of the transformer reactor mentioned. This primary current partially saturates the reactor core. The degree of saturation of the core depends upon the setting of an adjustable maximum current relay in the primary circuit, which can be arranged to "open" the primary circuit at any value of current up to 400 amp.

When the current in the primary circuit has built up to the desired value (degree of saturation) required for welding the gage of metal in use the maximum current relay trips, causing contactors to "open" the primary circuit. Since the resistance of the secondary circuit is then much lower than the primary the energy stored in the reactor (corresponding to the area under the magnetization curve up to the value of ampere-turns for which the relay is set) is dissipated through the secondary circuit as welding current induced by the decaying flux in the reactor.

Resistors Control Arcing

To avoid undesirable arcing at the primary switch and to control the decay of current in the secondary circuit four resistors in decreasing steps are connected across the primary switch by four contactors operating in successive order over a very short space of time after the maximum



OPERATIONAL ASPECTS of Sciaky welding system

(a) Energy stored in iron core of transformer reactor is released in secondary to do welding work. Energy stored is proportioned to area under magnetization curve corresponding to impressed m.m.f.

(b) Typical welding cycle shows variation of electrode pressure and current in welding circuit. Note small current flow during "charging" of reactor and heavy welding surge on release.

(c) Time control of welding surge is obtained by variation of secondary resistance. Current decay is determined by fixed resistance steps in reactor primary circuit.

current relay operates. The manufacturer claims that energy losses in the primary arc do not exceed 5 per cent.

There is a delay involved in saturating the reactor core to the desired value, which depends upon the electrical characteristics of the reactor coils (which determines the back e.m.f. against which the charging voltage must work in building up flux density in the reactor core).

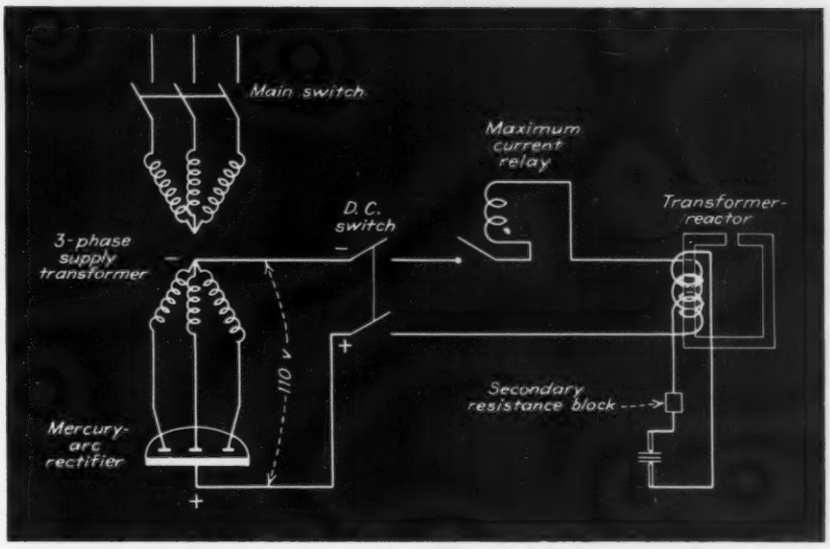
Preheating Effect

As current builds up in the reactor primary circuit, flux in the core is constantly changing and, as a result, there is a small current induced in the secondary circuit. This current flows in one direction during the charging of the primary and in the opposite direction during the welding cycle. The preliminary current has the desirable effect of preheating the material slightly.

The time during which the welding current flows depends upon the amount of resistance in the secondary circuit and can be varied to suit the gage of the material by inserting resistance blocks of different sizes into the secondary circuit. This resistance acts to reduce the slope of the front of the surge, shown in the accompanying sketch, whereas the decay of welding current, after it has reached its peak, is determined by the magnitude of the resistances introduced in the primary by the contactors mentioned.

It is the claim of the manufacturers that a 40-kva. Sciaky welder will perform the same welding duty as a 400-kva. conventional single-phase aluminum welder and that flicker is proportionately reduced. This, it is explained, arises from the fact that a relatively low demand exists during the period that welding energy is being stored in the reactor. This energy, when accumulated, is dumped almost instantaneously to make the weld. In a conventional resistance welder substantially the same energy is released to the weld, but all of it is drawn directly from the supply circuit at the instant of welding—creating a higher demand and making larger copper capacity necessary to supply the heavy circuits. Sciaky welders are capable of 40-60 welds per minute.

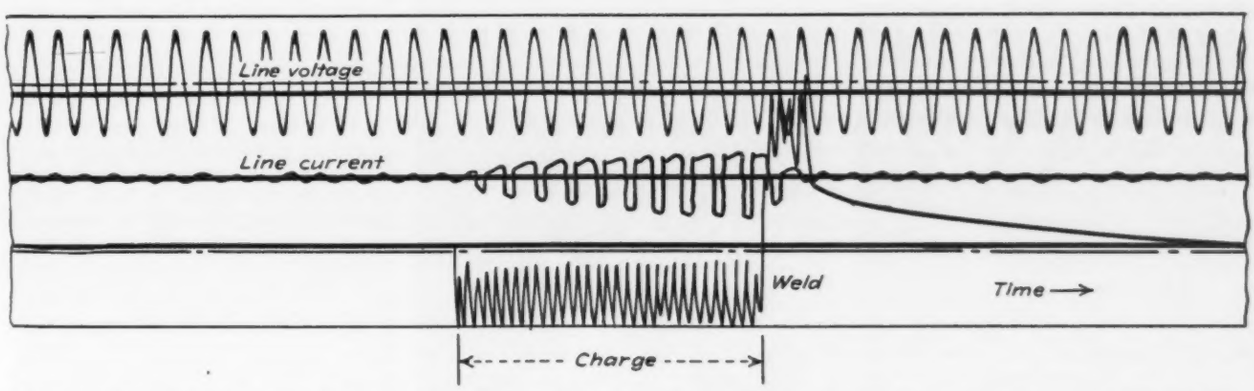
Use of a three-phase transformer to supply the mercury-arc rectifier balances the phase load and further contributes to satisfactory feeder performance. Conventional resistance welders use a single-phase welding transformer which places an unbalanced load on the supply line.



TRANSFORMER REACTOR is charged from three-phase mercury-arc rectifier. Adjustable current relay opens primary circuit at any pre-selected current value

Data on Line Current Draft of Aluminum Spot Welder

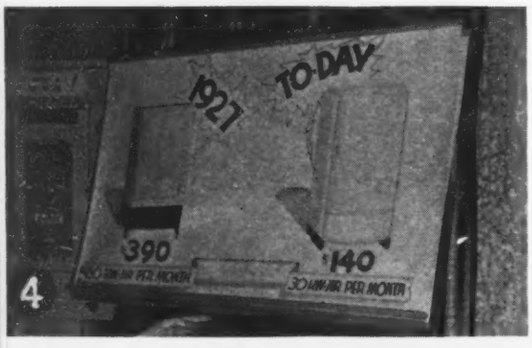
Thickness of Each of Two Sheets of Aluminum	Primary Current D.C. (Amp.)	Max. Secondary Current (Amp.)	Peak Voltage at Electrodes (Volts)	Max. Power at Electrodes Kw.	Total Energy Spent in the Welding (Joules)	Phase Current in Supply Line 440 V.
0.020	96	10,650	0.65	6.25	110	15.9
0.024	117	12,300	0.78	8.25	130	19.4
0.031	207	20,700	0.92	14.60	414	34.3
0.047	240	22,000	1.01	18.00	568	39.8
0.063	300	23,300	1.08	19.50	595	49.7
0.078	360	24,900	1.17	24.30	690	59.8

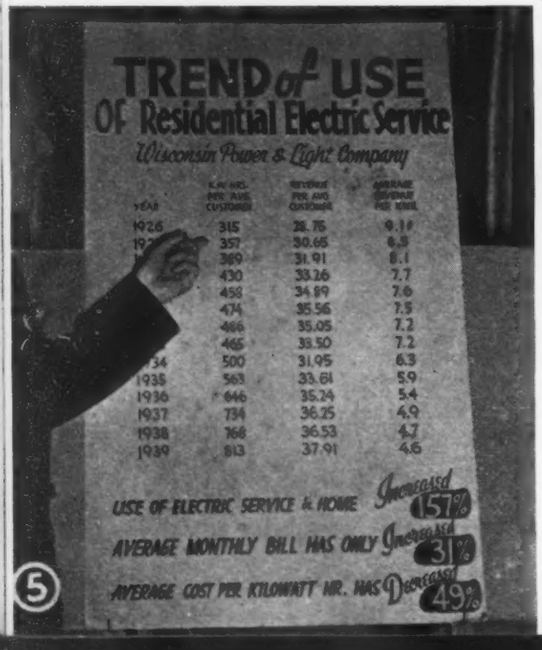


STORAGE PRINCIPLE and three-phase supply relieve supply circuit from the sharp voltage dip common to conventional resistance welders. Oscillogram was taken during actual operation

Adequate Wiring

A presentation by L. A. FALK,
Wisconsin Power & Light Company, Madison





1 *Old and New*—"Let's look at the history of development in this electrical industry! Sixty-one years ago this bulb in my right hand sold for $3.40 and used energy costing 25 cents a kilowatt-hour. Today this 100-watt bulb, which I hold in my left hand, costs 15 cents, gives ten times as much light and uses energy costing 4 cents a kilowatt-hour."

2 *Motors*—"Let's see what happened to the motors! In 1900 the 1-hp. motor in factory use cost $163 and weighed 242 lb. Today a 1-hp. motor costs $41 and weighs 70 lb."

3 *Radios*—"One of the greatest things that the electrical industry has brought into the home is the radio. It brings more joy and happiness to you and me than almost any other household appliance. In 1922 the radio that you see on this chart cost $250 and was a definite luxury, received nearby stations only, cost $5-$6 a month to operate, using batteries. Today $30 will buy a modern radio capable of long-distance reception which will operate for 25 to 50 cents a month directly through electric service."

4 *Refrigeration*—"Now, let's look at the electric refrigerator which the electrical industry has given to the public. In 1927 this box on the left cost $390 and used 60 kw.-hr. a month. The 1940 model we see here sells for $140 and uses only 30 kw.-hr. a month. Has any other industry given you as much for your money?"

5 *Trend of Use Chart*—"Now what has happened to the cost of the energy required to operate these appliances? In 1926 customers of the Wisconsin Power & Light Company paid an average of 9.1 cents per kw.-hr. In 1939, thirteen short years later, the customer paid an average of 4.6 cents per kw.-hr., but notice the three significant points at the bottom of the chart. In that 13-year period the use of electrical service in the home has increased 157 per cent, but the average monthly bill has increased only 31 per cent because the average cost per kw.-hr. has decreased 49 per cent."

6 *Who's Responsible?*—"Who is responsible for this decrease in the cost of electric service? Gentlemen, I contend that the advance in the electrical industry has been brought about by the enterprise of the men within the industry—electrical manufacturers, designers and operators. Let me show you an example. Here on the table are 7 lb. of coal. This was the amount required in 1900 to make 1 kw.-hr. of electricity. Here in this mason jar are 15 oz.—less than 1 lb.—powdered fuel, the amount burned in the average modern plant to generate 1 kw.-hr. Gentlemen, I don't believe that any one but the people in the industry can take credit for these advances."

7 *Wiring Chart*—"These technical advances which have reduced the cost of electric service and brought forth low-cost appliances have brought about an astonishing acceptance of electric service in the home. Utility companies in the past fifteen years have doubled their investment cost in their wiring systems to bring dependable service to homes, offices and factories, but only a very few customers have doubled the investments in their own wiring systems. The company has done its part in supplying electric service to you. What has happened to your investment? The company has done its part! Have you done yours?

Let's look at a typical home. This is not a model home, but just a home which has grown up electrically. Back in the early part of the century the owner put in four or five lights that looked pretty much like this one over here (No. 8).

in Tabloid Form

Utility interests, manufacturers' interests and contractors' interests take second place in this presentation, developed for popular appeal — Heavy demand from service clubs

8 He thought he would try out this new electric light and see if it worked. A few years showed that it did, so he added some more lights, in the bathroom, on the back porch, an extra light in the kitchen. Gradually, he added more and more lights, here and there a fan, a vacuum cleaner, refrigerator, a washing machine and other appliances, until there are now 57 outlets in this home where appliances and lights are attached to a system that was originally designed for only five lights. Now, let's see what that means in the type of service that this home gets."

9 *Inadequate Wiring Power*—"Maybe I can show on this board what happens when your house is inadequately wired. The lights are dimmer, as you can see from the bulb at the top of the board on the left. The motor, as typified by this disk in the middle, doesn't turn up so well. It takes longer to clean rugs and mix your food, but it worked well enough until Father brought home that new roaster, which we show symbolically by the heater at the bottom left. See how much dimmer the light is and how much slower the motor turns when this heater is attached to the system, and the roaster doesn't heat up as it should. See how much brighter the light is in the adequately wired installation at the right—how much faster the motor turns and the heating appliance comes to full temperature quickly."

10 *Relics*—"Let's go down cellar and look at the old fixtures we have in this inadequately wired home. A fuse with a hairpin in it. Another with a penny behind it. Old-fashioned metal snap switches. Home-made electrical connections. This display is not to frighten you, but merely to show you some of the old-fashioned fixtures that are being used in homes to supply modern appliances and which are a definite hazard."

11 *Cost of Inadequate Wiring*—"When you have overloaded the distribution system in your home you can pay for as much as 20 per cent of the energy that you never get because of wiring loss. This display shows this fact to you graphically. Take the coffee maker at the top of the table. These are used an average of five hours per month. If there is no voltage drop in your system it will cost you 14½ cents a month to operate the coffee maker on energy at 5 cents per kw.-hr., but with a 10 per cent voltage drop in an inadequately wired home you pay 17 cents per month to operate the same coffee maker. This is an increase of 2½ cents in the monthly cost, and the time that you lose per month because the coffee maker does not come up to temperature as fast is one hour and 18 minutes. This cost is similar for other appliances listed here."

12 *Do Something!*—"This problem of adequate wiring for your home is your problem. When you go home tonight notice if your lights dim when your refrigerator goes on or when you plug in your toaster. If they do, *your* home is inadequately wired. *You should do something about it.* See a reliable electrical contractor or come down to our office. We will be glad to help you plan the rewiring of your home. I thank you."

Editorials

S. B. WILLIAMS, *Editor*

December Peaks Discount Power Shortage Fears

MORE AND MORE it appears that fears of an electric power shortage, so widely publicized, rest on very slight foundation. Here is the latest evidence.

It was expected that the sum of non-coincident peak loads on electric utility systems would increase about 10 per cent from December, 1939, to December, 1940. The November increase was 9 per cent, October 8.6 and September 7.2. It was reasonable to anticipate that the December increase would continue the rising curve. But it did not. Instead preliminary figures show it dropping to 7.6 per cent.

The increase in energy output from electric utility systems did not fall off in any such startling fashion. On the contrary, it grew from an increase of 8.8 per cent in November to 9.8 per cent in December.

Thus, while energy output continued to maintain its accelerating rate of increase in December, peak loak did not.

Traditionally, December has been the month in which annual electric system peaks occur. That tradition, like many others in this day, no longer has the strength it once enjoyed. System peaks in other months of the year are now common enough to go unremarked except by those who see them for the first time. Nevertheless, and again like other traditions disregarded in our time, the December peak had, still has, much of validity in it. In December come the shortest days of the year and with them the highest wave of retail buying, both powerful in effect on electric system loads. Yet in spite of these factors, the sum of peak loads in December, 1940, was less than was anticipated. Not just a little less, but almost a quarter less.

Part of the reason for this decline from the expected is undoubtedly to be found in the generally fair weather that prevailed over the country in December, 1940, as against the stormy weather of December, 1939. But also the cause lies in the fact that the accelerated production speed of our national industrial machine is being accomplished by more intensive employment of existing facilities rather than by expansion of them. This conclusion is plainly indicated by the continuing upward trend of output increase in December.

On the other hand, the deceleration of peak load increase indicated by the December figures cannot be taken as proof that electric system loads will not grow as fast as some say they will. The evidence of a single month, striking as it may be, is not enough for that. But on this evidence it certainly may be said, as has so often been said in these columns, that there is less cause than some assert for getting all excited about the possibility of a power shortage.

Another Leader Steps Down

WITHIN a few days another utility pioneer will retire. We refer to Harry Shearer of the Pennsylvania Edison Company of Altoona, as likable and sincere a man as you will find anywhere. Mr. Shearer's contribution to this industry was his pioneering in public and employee relations. His company has been a consistent winner year after year, at the Pennsylvania Electric Association convention, of the safety award for his group simply because of his insistence that employee safety was worth working for. His townsfolk a few years ago at a large banquet presented to him a scroll naming him one of Altoona's leading citizens.

His latest effort in public relations, started five years ago, is now on a self-liquidating basis. A group of forty-five district representatives have more than earned their keep. Economies in other departments have resulted from their work, in addition to reduced loss from current diversion, improved collections and fewer cut-offs, plus the bonus of bettered public relations.

As we look back over Mr. Shearer's activities, we cannot help thinking how different the utility future might look if more utility executives had had the same vigilant respect for public good will that he did.

Electric Service Under Bombing

LITTLE BY LITTLE reports trickle in on the effect of bombings on electrical supply in England. The latest is contained in the December 13 issue of *Electrical Review*, which reports outages in many areas up to twenty minutes, but "a remarkable absence of the prolonged and widespread failures which might have been anticipated." Gas, water, public transport and communication services have suffered much more than electricity.

There are apparently two reasons for the record of electric service continuity. First is the toughness and resiliency of underground equipment and the other is the spirit of electric utility employees.

When a bomb hits a roadway in many instances it fractures gas and water mains, thus affecting the supply for the adjacent area. Electric cables, on the other hand, may be bent, twisted or stretched without failure. When repairs are necessary, a temporary, makeshift job is done first, the more permanent repairs being undertaken at a later date when rubbish has been removed and road repairs started.

Praise is given by the English journal to the devotion of utility employees. No other group tries so hard to keep down service outages. If trouble occurs in one area

employees from another are quick to give their assistance if needed. Utility people in this country will probably see nothing remarkable in that because it is only what they would expect. Electric utility employees have been trained to give service day or night, rain or shine, hot or cold. Nor does it make any difference where the trouble occurs. They are on call to maintain their own or neighbor's service. To restore service after the New England hurricane crews came from beyond the Mississippi, and last fall when Amarillo lost its service in a freak sleet storm fourteen neighboring companies sent assistance.

This training to act in emergency, this ingrained devotion to maintenance of service, is but another phase of preparedness. All of the reserve power imaginable would be of little value if bombings could and did destroy distribution facilities. The service is protected not only by adequate generating capacity and interconnection but by well-engineered transmission and distribution and by employees with years of emergency training.

Credit by Default

THE American Institute of Electrical Engineers is breaking a practice of long standing next week by holding its midwinter meeting away from New York. The annual meeting in June, on the other hand, is held in different sections of the country. For a long time the midwinter convention was looked upon as the technical meeting and the summer gathering as more social. Of late, however, the summer meeting has become much more technical.

Next week's program is no different from that of any previous midwinter meeting except perhaps that there is more of it. During the five days no less than 82 papers are scheduled for presentation in 29 paper and conference sessions—a tremendous program.

While it is possible that the papers and discussions may provide the link that ties electrical engineering to the life of the country, the most important phase of which at the moment is national defense, one would search the program in vain to discover that the United States was involved in a great emergency. Last week, when the Civils were meeting in New York, the program gave specific attention to defense. Last December the Mechanicals did likewise. Surely electrical engineers are equally interested in defense and surely they have as much to contribute as any other major branch of engineering.

National defense is raising problems for electrical engineers of all categories, and, as would be expected, they have been anticipating the needs and preparing for them. That activity pertains not only to the purely technological solutions but also to protection of facilities against bombing and sabotage, so that our economy and social security may be preserved through any emergency. It is somewhat unfortunate, therefore, that this public service of the profession is not reflected tangibly in the program.

Without questioning any policy of the institute of refraining from opening up controversial questions off on the fringe of electrotechnology, it is to be regretted that the national forum of the profession by default permits public recognition of electrical engineering alertness and sense of public duty accorded to other groups which must have less appreciation of what is wanted, what is being done and what can be done to make the nation secure so far as electrical engineers can contribute to the grand cause.

Now's the Time to Advertise Utility Power

ONE OF THE leading utility commercial executives said recently that utility employees look upon the Diesel engine as a competitive threat, not for the real reason, but because Diesels can generate electricity for less than the customers can buy it from a utility. If that is so, and we suspect it is, why doesn't somebody do something about it?

The real reason why Diesels appear as a threat to utility service is because utility executives either have brushed the matter aside as something too small to bother about or else have been satisfied that their power sales people could and would successfully cope with the situation. At any event, too few companies have, through advertising, seen fit to lock the barn door before the horse was stolen. Engine manufacturers, on the other hand, have been very active in telling utility customers they could save money by substituting Diesel power for purchased power. The obvious result is that in every instance the utility—the service that has been so dependable for years—is put on the defensive and made to prove its case.

A few years ago power sales groups asked their company executives to set up a national publicity campaign to sell the advantages of purchased power. The passive resistance to the proposal was too much for it. At the present time there is little competitive activity because the Diesel manufacturers are busy turning out mobile units. Defense and shipping are providing more attractive markets for the moment than are stationary units. For that reason this is a good time to tell the story of purchased power.

How many factories in the past six months have made sudden demands on utility service? Could they have secured the same services from Diesel manufacturers? Right now industrial customers can appreciate the security, flexibility and dependability of purchased power. This, then, should be a good time to protect the market against future inroads.

Utility power sales forces are good, but not so good that they can do this competitive job unaided. They need support. They need a unified publicity program. They need it as much in Pennsylvania as they do in Georgia. There is no locality that is any different from the others.

Let's tell the industrial world that the cost of service is something other than the uncertain cost of oil. Let's boast about the advantages of purchased power, and then perhaps our employees as well as our customers will know that there is no better power or less expensive power than purchased power.

A Chunk of Pork Under Any Other Name—

By CARTER FIELD

This noted journalist gives his personal comments and interpretations on current happenings affecting the electrical industry. His background and his location at Washington make his thoughts informative and interesting even though all may not agree with him

REMEMBER the pork barrel bills?

Back in the years just before World War No. 1 they were a scandal. Nobody was advocating the totalitarian form of government—publicly anyway—at that time, or they certainly could have used the annual rivers and harbors raid on the Treasury for local political purposes as one reason a dictatorship might be pretty sound from the standpoint of the taxpayers.

Then came the famous filibusters, led by Senator Theodore Burton of Ohio, which gradually built up so much popular opposition to the pork barrel system that it was changed. We still have the pork barrel, but at least it is run on the totalitarian system!

So few people seem to understand how it operates, especially in these days of billions for defense, but not one cent for profit—except political profit—that perhaps a brief explanation is in order. Especially in the present situation, where the White House announces that all non-defense appropriations are to be cut to the bone, and everybody is wondering how big some of these bones are.

How It Works

The system gradually evolved for outwitting the pork hunters, and yet leaving some bacon for the boys in Congress to take home to their constituents, and thus get re-elected, is something like this.

First, Congress passes a bill directing the Army Engineers to survey a certain project. It is no trouble for any project to hurdle this first handicap. Then the engineers, with a weather eye cocked on future promotions, future appropriations for their own service, personal friendships for certain gentlemen—and ladies—on Capitol Hill, and last but not least in the White House, study the project.

In due time the engineers report, having weighed the merits of each particular project on the list scrupulously, and with the elements aforesaid carefully computed. Not always, but generally the report, strangely enough, is favorable, or at least can be so translated by its advocates.

Now comes the second hurdle, much higher than the first. The project must be authorized. That is, Congress must specifically approve the project being put on a list from which the projects actually to be done are to be selected. Then Congress votes a sum, usually under $100,000,000 for a year, to finance such of the projects as may be selected from this list.

But It's Still Pork

Note that Congress no longer—as in the old pork barrel days—actually makes the final decision as to which projects shall be done this year coming and which shall be left over. That is the third hurdle, and by far the highest. That choice is made, theoretically at least, by the army engineers. There is always a host of projects on the "authorized" list, which means that they have passed the first two hurdles. Some of them, everybody knows, including the congressman who initiated the first study and dickered with his fellows to get the "authorization," will never reach the pick-and-shovel stage. But don't forget that the congressman in question can always point with pride to his constituents how he is fighting to divert federal funds to his particular creek or coastal indentation.

To these three hurdles the President has now added a fourth. Even if the engineers like a project on the authorized list, it must now be sanctioned by the National Defense Commission.

It sounds very sane indeed, but, as the sneezing student explained to the tiresome lecturer, he was not spreading germs, he was just allergic to baloney!

Because the pork barrel is still there, and the smart pork grabbers on Capitol Hill have adapted themselves to the new rules. They have to do their trading with the White House, now, instead of with their colleagues. But all the old timers have got rather adept at that technique.

But how about the budget, one may ask.

Well, in the budget the river and harbor appropriations were cut to less than half of those for the present fiscal year. Some of those left have a defense flavor, as, for instance, the Delaware River up to the Navy Yard, and harbor improvement at Long Beach, Calif., for both of which the navy was anxious. Others were mostly mere continuances of work already under way.

Flood control was left about the same—around 70 millions, and again mostly for projects already started. Last session there was a bill to authorize a lot of new flood-control projects, but it did not pass.

Best opinion obtainable at the moment is that nothing new will be done in this line—unless—the Defense Commission interests itself in some new power projects!

Slicing the Bacon

There is some speculation at the moment about the White River (Arkansas and Missouri) situation. The engineers have approved eight dams in all. Two of these have been authorized, the Clear Water, now under construction but with no power angle, and the Norfolk, which does contemplate power and for which the main contract is about to be let.

There are some shrewd guesses that

[*Continued on page 91*]

NEWS OF THE WEEK

Two New Federal Power Bodies Proposed in Bill

Would create authorities similar to TVA to cover Bonneville-Grand Coulee and Arkansas Valley — Columbia Power Administration would provide means of acquiring private utilities

Creation of two more federal power authorities similar to TVA is proposed in legislation already before the new Congress. The bill indorsed by Secretary Ickes to set up a Columbia Power Administration as an agency in the Department of Interior to socialize electric energy distribution in the Pacific Northwest has been reintroduced by Representative Hill, Washington Democrat. Senators Miller and Hattie W. Caraway of Arkansas propose establishment of an Arkansas Valley Authority as an independent federal agency to develop power and control floods on the Arkansas, St. Francis, Red and White rivers.

Columbia Power Authority

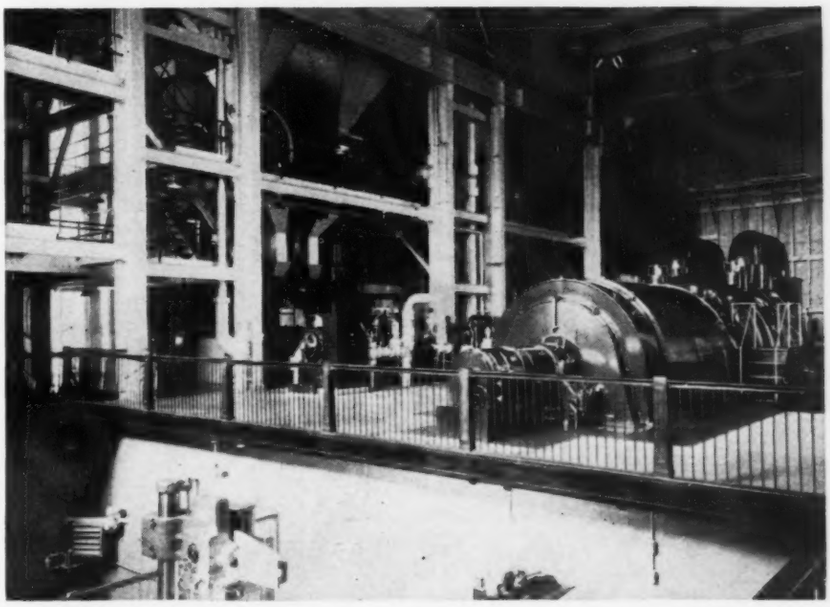
New Dealers look to the Columbia Power Administration measure as the vehicle for taking over the Puget Sound Light & Power Co. and other private utilities for consolidation with Grand Coulee and Bonneville power dams to create a vast government power pool in Washington and Oregon. This proposed setup, in several important respects, is sharply different from the pattern of the New Deal's first experiment in socialized power, the TVA. Yet the bill is considered likely to pass and become a law.

The measure proposes a single administrator appointed by, and subject to, the Secretary of the Interior, instead of an independent board of three men reporting to the President as in the case of TVA. The Columbia Power Administration, furthermore, is limited solely to authority over sale, transmission and, for temporary periods, distribution of power; operation of the two federal multi-purpose dams is continued with their present agencies — Bonneville under the Army Engineers and Grand Coulee under the Bureau of Reclamation. This again departs from the TVA pattern, where the authority not only distributes the power but also owns and operates the generating plants and carries on, as well, the related objectives of the experiment.

The bill would give the Columbia Power Administrator authority to acquire by purchase, lease, condemnation or donation whatever property of existing private utilities he finds "necessary or appropriate" to carry out the purposes of the law. He must, however, sell to local public agencies or co-operatives such distribution facilities as are acquired as promptly as possible. For financing purchases of private properties, the Administration is authorized to float government-guaranteed non-mortgage bonds up to a total of $200,000,000 outstanding at any one time.

Bonneville Law

The existing Bonneville law provisions requiring that public agencies be reserved 50 per cent of all power available for sale until July 1, 1943, is continued in the proposed measure, and the



HUTSONVILLE STATION—Turbine and boiler room interior of Hutsonville generating station of Central Illinois Public Service Company showing the 25,000-kw. No. 1 unit. A second similar unit is to be added to the station. The new unit, like the first, will operate on steam at 650 lb. pressure and 850 deg. total temperature. Steam will be supplied by two 150,000-lb.-per-hour pulverized fuel-fired boilers

MOBILE SUBSTATION—Central New York Power Corp. receives the first completely factory-built 1,000-kva. mobile substation as an added precaution to assure service continuity to defense industries in the Syracuse area. L. to r.—John L. Haley, president Central New York Power Corp.; Ralph M. Darrin, Syracuse manager General Electric Co.; Minot H. Pratt, electrical engineer Central New York Power Corp.

rates and practices now in effect on the Bonneville and Grand Coulee projects are carried over to the Administration. Practically all policies of the administrator are subject to the approval of the Secretary of Interior.

Provision for reimbursing municipalities for lost tax revenues through purchase of private utility property authorizes the administrator to make payments not to exceed the average tax receipts in the three years prior to acquisition. Amount of the payments is fixed by the Administrator with provision made for appeal by the municipalities to the Secretary.

The Miller-Caraway bill, on the other hand, follows the TVA pattern in proposing establishment of a federal corporation headed by three directors appointed by the President with Senate approval, and with authority to construct dams, sell power and issue bonds. This agency, presumably, would begin operations by assuming jurisdiction and ownership of the existing developments in its area.

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Northern Indiana Power to Spend $1,000,000

With a construction budget totaling more than $1,000,000—one of the largest to be authorized in recent years—Northern Indiana Power Co., Indianapolis, will continue through 1941 a program of modernizing and expanding transmission and distribution facilities—both gas and electric.

While no major construction projects are contemplated, Chief Engineer John Walker has announced that distribution lines in many districts will be rebuilt and, in some cases, extended in order to improve voltage conditions and assure adequate service to our customers.

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Philadelphia Electric to Spend $50,000,000

Philadelphia Electric Co. will undertake a construction budget this year of approximately $50,000,000, according to Horace P. Liversidge, president. This is the largest volume of construction work planned for one year in the history of the company.

The largest single item in the program is the new Southwark generating station development on the Delaware River in South Philadelphia. Present plans for this development provide for an ultimate capacity of 600,000 kw. Mr. Liversidge said that the company expects that the first turbo-generator unit, of about 150,000 kw. capacity, will be ready for service in 1944, and the second unit shortly thereafter.

Approximately $12,000,000 will be spent on additions and improvements to the transmission and distribution system.

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Authorizes Steam Plant

The Wisconsin Public Service Commission has authorized the Superior Water, Light & Power Co. to construct a 12,500-kw. steam-electric plant at its Hughitt Avenue station at a cost of about $1,550,000.

New York Utility Gets Mobile Substation

Delivery was made last week to the Central New York Power Corp. of Syracuse of what is presumably the first completely self-contained mobile substation, designed by the utility's engineers and built by the General Electric Co. at its Pittsfield, Mass., plant.

Mounted on a special chassis, the 1,000-kva. unit can be hauled at speeds up to 40 miles per hour and will be used for quickly supplying or restoring power to defense industries and other customers in a serious emergency as well as to by-pass regular substations while repair or maintenance work is being carried on. Engineers of the Central New York Power Corp. estimated that the mobile unit will probably be in use about 75 per cent of the year.

The substation consists of one three-phase, 1,000-kva. transformer with primary and secondary switching equipment and lightning arresters. It is designed to take power from high-voltage lines of 11,000, 13,200, 22,000, 33,000 or 44,000 volts, transform it and supply it to systems of 230, 460, 2,300, 4,000 or 4,600 volts. Installation is merely a matter of parking and grounding the unit, attaching incoming high lines to one side and secondary system lines supplying the customer to the other.

Including extensions, the mobile unit is 11 ft. 6 in. high, 21 ft. long and 8 ft. wide, although the height can be reduced to 9 ft. 10 in. for low clearances. Total weight, including chassis, is almost 10 tons. Use of a forced oil cooling system permitted the substation to be built in compact weight and size.

In addition to its new mobile substation, Central New York Power has located at the strategic cities of Syracuse, Utica and Watertown universal-type 2,500-kva. transformers, with secondary oil circuit breakers. These can be used separately for customers' emergency requirements, or jointly in connection with the portable substation. Used in this latter manner, a total capacity of 8,500 kva. can be obtained, sufficient to carry temporarily the requirements of a large community or industry.

General Electric now has in manufacture at its Pittsfield, Mass., works three more mobile substations for individual utility customers. According to the company, mobile units in ratings up to 3,000 kva. can be built to come within the road limitations of most states.

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Plant Improvement

Poplar Bluff, Mo., contemplates improvements to its municipal power plant to cost about $200,000.

Urge Utilities to Analyze New Load to Investment

President Davis tells Missouri Valley Electric Association power sales conference that retarding factors dictate caution in accepting undesirable new load

Since the utility industry does not have a power shortage, and probably will not have one, it is more important now than ever before for it to analyze prospective new loads and the relation of this load to necessary investment for more capacity, George A. Davis, vice-president of Oklahoma Gas & Electric Co., declared last week in Kansas City.

Speaking as president of the Missouri Valley Electric Association before the annual power sales conference of the association, Mr. Davis explained that while the position of the industry was improved and public good will was growing the retarding factors of investor fear and difficulty in getting equipment dictated caution in accepting undesirable new load. Careful analysis of new business, giving first consideration to the needs of the community in which the company operates, he declared, is of prime importance now.

Municipal Agitation

J. A. Federhen, Oklahoma Gas & Electric Co., in discussing municipal ownership agitation, warned power salesmen that a company's future operations are judged by its past and the best way to combat agitation is to prevent it. Pleasant, accommodating personnel, efficient, reliable service and rate reductions when reasonable will go a long way toward preventing agitation. For combating agitation he offered several suggestions: Co-operate with the local press, keep general office people in the background—strangers are viewed with suspicion, set up an organization of local employees, throw a strong light on all phases of the proposed plan.

E. A. Nickelson, Interstate Power Co., summarized typical arguments used by proponents of municipal ownership and told how they could and should be met. He described in detail several threat cases and explained how they had been met by his and other companies.

P. A. Stover, Iowa Electric Co., expressed conviction that utilities may now expect a lull in municipal agitation due to the rush of defense orders for Diesel engines. The time is ripe now, he felt, for companies to take action on pending franchise elections. Concurring in this opinion, G. A. Davis, Oklahoma Gas & Electric Co., urged power salesmen to enlist support of large industrial power users in combating agitation.

W. H. Steve, Oklahoma Gas & Electric Co., presented statistics on the cost of operating gas engines covering investment, maintenance, fuel economy, lubricating oil consumption, life, operating labor and reliability. He estimates that at present 18.3 per cent of gas engines installed in the past year were traceable to poor public relations. This contrasts with 10 per cent in 1933, pointing, he believed, to poorer public relations in recent years.

A forum on competitive industrial power problems was conducted by Duane Landon, St. Joseph Railway, Light, Heat & Power Co., St. Joseph, Mo., with case histories on gas engine and Diesel completion presented by a number of companies.

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Egan and Union Electric Indicted by Grand Jury

A two-year investigation of the Union Electric Co. of Missouri, subsidiary of North American Co., by the federal government resulted in indictment of the utility and its former president, Louis H. Egan.

A federal grand jury charged Mr. Egan and the company with conspiracy and violation of the corrupt practices section of the Public Utility Holding Company Act through contributions to political parties and candidates.

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Grants Northwestern Plea

FPC has granted the petition of Northwestern Electric Co. requesting a stay of the commission's order relative to compliance with its Uniform System of Accounts, pending action on a proposed application of the company for rehearing.

The commission's order, during the period of the stay, prohibits the com-

POWER SALES—Seen during the power sales conference of the Missouri Valley Electric Association last week were (l. to r., standing) F. A. Graham, Kansas City Power & Light; C. E. Murphy, Sioux City Gas & Electric; Ford Bates, Nebraska Power, and (seated) W. H. Steve, Oklahoma Gas & Electric, and Don McKee, Empire District Electric. At right is G. A. Davis, president of the association, at the piano, while delegates gathered around during the luncheon recess

pany's declaring and paying any dividends on its common stock until after meeting the requirements of the earlier order. This provision of the earlier order requires that the balance of the company's income each year beginning with 1940 remaining after its preferred stock dividend appropriations shall be applied toward the amortization of a $3,500,000 common stock write-up until such amount is extinguished. The earlier order also provided for the transfer from the company's fixed capital accounts of $243,953 of capital stock expense to a separate book account.

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Central Maine Power Locates New Station

Supplementing the Central Maine Power Company's plant expansion program (ELECTRICAL WORLD January 4, 1941, page 5) for 1941, President Walter S. Wyman announces that the location of the new tidewater steam station will be at Wiscasset, on a site at Birch Point about a mile below the village on the Sheepscot River. The company has purchased about 50 acres of level land underlaid by rock suitable for foundations, and there is space on the property to provide additional capacity up to a maximum of 200,000 hp. and fuel storage for six months' operation. A fresh water stream which will furnish an ample supply for boiler feed flows across the land and tidewater deep enough to float the largest oil tanker or coal barge comes close to the shore. The initial equipment, a 25,000-hp. steam unit, is scheduled for delivery between April 1 and October 15 of this year. Mr. Wyman stated that this site should provide all the space the company needs for steam power expansion for many years.

In connection with the establishment of the Wiscasset plant, a 20-mile long, 110-kv. transmission line will be built to the company's Windsor substation. A 33-kv. reconstruction of the Farmingdale-Bath line will be required, and about 7.5 miles of new 33-kv. line will be built to provide a connection between Wiscasset and Bath. It is planned to have these new lines ready for service about July 1, in order to provide ample capacity for the important shipbuilding industries at Bath and Brunswick, now being supplied mainly from Lewiston and a small hydro plant at Brunswick. "A vigorous effort," said Mr. Wyman, "will be made to get the new steam plant into operation by January 1, 1942. By that time it is believed that the defense program plus the ordinary demands of the area will absorb a large part of the power available."

NEWS BRIEFS

CHANCES ARE that it will be some time before Standard Gas & Electric Company's President Leo T. Crowley will be allowed to leave his FDIC post in Washington. President Roosevelt has had Mr. Crowley's resignation for a long time, but he will not allow it to become effective.

JOHN H. MCKENNA, utility sales manager of Knapp-Monarch Co., has been elected president of the Electrical and Gas Association of New York. He succeeds David S. Youngholm, vice-president of Westinghouse.

NATIONAL ADEQUATE WIRING BUREAU has appointed Victor R. Despard, vice-president of Pass & Seymour, Inc., to the executive committee.

WISCONSIN ELECTRIC POWER CO. shot one-two-three in the Modern Kitchen Bureau's 1940 retail water heater salesmen's contest. Carl I. Hellen won first prize for the first half of the year's contest and Fred J. Wrobbel not only copped the first prize for the fall contest but snared the brass ring in winning the grand prize for the entire year.

GOOD ADVICE to American business was given this week by National Broadcasting Company's Vice-President and General Manager Frank E. Mullen in a speech before the St. Paul Advertising Club. American business must begin now to prepare for peace with as much vigor as it does for a possible war if we are to guarantee the continuation of our American way of life, says Mr. Mullen.

WISCONSIN PUBLIC SERVICE CORP. boasts that some of its boys on the line crews, after working better than 48 hours in a recent sleet storm, got rid of "excess energy" at pingpong tables in the company's service department.

IMPROVED DESIGNS for underground risers and overhead layouts where more than two services for power and communications are supplied from a jointly used pole are up for discussion in engineering circles. Limitation of the number of riser pipes per pole has been an objective of utilities for some time.

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Oppose St. Lawrence

The National St. Lawrence project conference was organized last week in Cleveland to further plans to prevent a diversion of the country's resources through immediate construction of the St. Lawrence seaway and power project. The organization was brought about at a conference of representatives of public authority, commercial interests, transportation, mining and labor.

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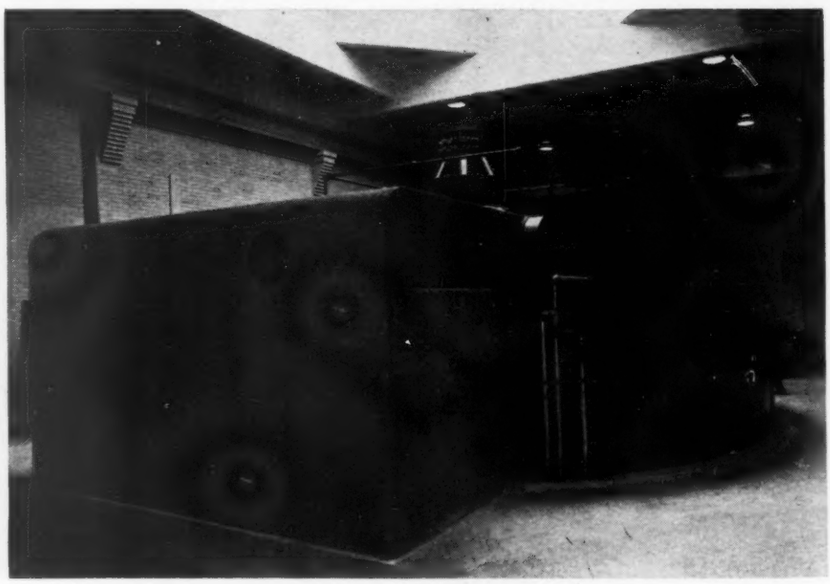
To Vote on City System

The Spokane City Council adopted by a four-to-one vote an emergency ordinance referring to the voters on March 11 the proposal for the city to take over the electric distribution system of the Washington Water Power Co. It is estimated that a municipal system would cost about $6,500,000.



COMPLETES PLANT—Central Maine Power's Wyman hydro-electric station at Bingham adds third and final unit, bringing capacity to 75,000 kw. A 25,000-kw. G.E. generator driven by an Allis-Chalmers waterwheel rounds out this major development on the upper Kennebec River. Engineering was by Nepsco Services, Inc.

Present Power Problems Viewed at A. S. C. E. Meet

Protection of power faiclities in case of war, allocation of costs of TVA projects and engineering aspects of depreciation among subjects discussed at New York convention

Protection of power facilities in case of war, allocation of costs of the Tennessee Valley Authority projects and engineering aspects of depreciation were among the subjects discussed by the more than 2,000 engineers who gathered in New York City last week for the eighty-eighth annual meeting of the American Society of Civil Engineers.

Philip Sporn, vice-president and chief engineer of the American Gas & Electric Service Corp., stated, in a paper read by Major H. S. Bennion of the Edison Electric Institute, that the larger amount of installed capacity in 1940—a ratio of almost five to one compared with 1917—constitutes a factor of safety in itself. Furthermore, the additional capacity now going in—at least 7,560,000 kw. in the 1941-1943 period—is one form of the additional protection needed.

Protect Against Outages

Several agencies, including the Federal Power Commission and a group of utility engineers, have worked on the problem of protecting against outages and restoring service quickly when capacity has been put out of service, Mr. Sporn stated in his paper. Data are needed, however, on the extent of damage possible and the A.S.C.E.'s Committee on Civilian Protection in Case of War, set up last October, hopes to gather this information.

Even with precautions, it is still possible to lose power. Remedies for this situation include distribution stations on tires, in sizes up to 3,000 to 5,000 kw.; there are being developed mobile (on railroad trucks) high-voltage transmission stations up to 15,000 kva.; Diesel plants on wheels, steam-generating plants on railroad cars, larger steam-generating plants on barges or ships—all these are being studied, Mr. Sporn wrote. The committee plans to put out information on all of these and to see that lack of power will be no cause for blackout, actually or even figuratively speaking.

Another speaker at the round-table discussion on civilian protection was Allen J. Saville, consulting engineer, Richmond, Va., who advised a study of power layout with the object of determining vulnerable spots and a special study of any substations serving large industrial areas.

Allocation of costs of the TVA projects was made as directed by act of Congress, Theodore B. Parker, chief engineer, TVA, pointed out at a meeting of the waterways division. He explained that this allocation is not based exactly on any one mathematical formula, but that the final figures were fixed by judgment, guided by a determination of the costs on the basis of the "alternative justifiable expenditure" theory. In the adopted system allocations, 52.5 per cent of the total costs is allocated to power for a three-plant system. This figure decreases to 51.9 per cent for the seven-plant system. Taxes are not included in the cost allocations, though operating expenses are, Mr. Parker stated; depreciation reserves have been set up in a special account, independent of allocations. Mr. Parker added that the allocations have not as yet been used in setting power rates, but declared it has been found that the rates in effect would produce revenues sufficient to retire more than all the cost of generation, transmission and distribution of power, including interest.

As an "academic" criticism of this allocation, William P. Creager, consulting engineer of Buffalo, N. Y., felt that the alternative justifiable expenditure theory "might" lead to unfair competition and produce a "big stick" rather than a "yardstick." With a power allocation amounting to 62 per cent of the alternative power costs—expense of building a power plant alone which would have equal capacity and output as the three-purpose projects—book profits would be "excessive" if the power was sold at the market rates prevailing in the area served, while unfair competition would result if the rates were lower. He advocated that the maximum justifiable cost allowable for power be used in allocating total costs.

In answer, Mr. Parker said that the government gets the power more cheaply from a three-purpose plant than it would from a single-purpose project.

Depreciation Symposium

Terming the depreciation problem as "rather definite and certainly pressing," J. A. Walls, president, Pennsylvania Water & Power Co., told the symposium, sponsored by the power division, that: "first, a sound basic concept or common understanding of the true meaning and scope of depreciation must be developed. Second, an orderly and basically sound procedure for measuring depreciation must be formulated which will employ the vast volume of technical and scientific data and methods available, and above all, a procedure which will yield comparable results under comparable conditions and circumstances. Third, an orderly and basically sound procedure of deriving estimated rates of depreciation for the future from our measurements of past depreciation must be formulated." Even so, he cautioned, sound judgment will still be needed in the treatment of the problem.

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Ice Storm in East Breaks Power Lines

The ice and sleet storm which hit the New York area and adjacent parts of the Northeast last week felled utility lines and left customers without electricity until linemen could repair breaks.

The southern part of Westchester County, adjoining New York City, was hardest hit, with some damage to service lines in the White Plains, Scarsdale, Mount Vernon and Yonkers areas, but only two poles were down in the entire county. Approximately 1,000 customers of Westchester Lighting Co. and Yonkers Electric Light & Power Co. were affected. The two utilities had about 100 extra linemen on duty during the storm, augmenting the regular emergency crews. Normal service was quickly restored for the most part.

There were breaks in service on Long Island and in New Jersey, but interruptions were not as numerous or as serious as in other such storms. Staten Island was hard hit when trees felled power lines and nearly every town on the island was in either partial or total darkness.

Rain, which fell during the night, helped to keep down the damage to property.

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Rules Against Tax

The Michigan State Supreme Court has ruled that the 1939 Legislature erred in giving immediate effect to an act imposing the 3 per cent sales tax on sales by municipal utilities. Municipal utilities were granted a refund of taxes paid under protest between June 22 and September 29, the date when the measure would have taken its normal course and been effective on the latter date.

Utility in New Jersey Gets 50,000-Kw. Unit

Continuing its policy of preparing for any eventuality in the national defense program, Public Service Electric & Gas Co. has placed an order for an additional 50,000-kw. turbo-generator at Marion generating station, Jersey City. The cost of this unit will be approximately $4,000,000 and the company expects it to be in operation by November 1, 1942. Work preparatory to its installation will proceed immediately.

The new turbo-generator will operate in conjunction with the 50,000-kw. unit and the two high-pressure boilers being installed at the station for operation early this summer and, when completed, the combined units will be a duplicate of the new 100,000-kw. cross-compound unit in operation at Burlington.

With the installation of this unit, together with other units now being installed, the combined capacity of the five company stations in the autumn of 1942 will be 1,037,700 kw., or 200,000 kw. more than the capacity at the end of 1940. In addition to this are important interconnections with neighboring companies which provide load and reserve diversity capacity, as well as capacity for use in emergency.

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A.I.E.E. Sponsors Series of Defense Broadcasts

Enlistment of the far-reaching resources of the electrical engineering profession in the Army, the Navy and in defense production has been selected as the subject of a series of Monday night broadcasts over the Blue Network of the National Broadcasting Co., according to the A.I.E.E.

The fifteen-minute programs will be scheduled to run from 7:45 to 8 p.m. EST, starting January 27. The first program will originate in Philadelphia on the opening day of the winter convention of the A.I.E.E.

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Johns Hopkins University Offers Defense Training

Johns Hopkins University is offering ten courses of college grade under the sponsorship of the Engineering Defense Training Program. These courses are under the supervision of W. B. Kouwenhoven, dean of the school of engineering.

Among the courses offered is a full-time day course designed for the training of material inspectors. This course was arranged at the request of and with the co-operation of the Ordnance Departments of the Army and Navy. The work will include both lectures and laboratory practice. Classes will begin February 3. Successful completion of the course will be accepted by the Civil Service Commission as equivalent to one year's experience.

•

Board Permits Utility to Build New Line

Illinois Iowa Power Co. has been granted a certificate by the Illinois Commerce Commission authorizing construction of 10.25 miles of 34,500-volt power line from Centralia northeast to the vicinity of Lake Centralia, where the power company serves several oil-producing companies.

At present the power company has a 33,000-volt substation in the vicinity, fed from a power line extension with its source of supply at Collinsville, 60 miles distant. Growth of use of power in the area warrants building of a new line. Revenue earned by the company in the area served by the substation is approximately $200,000 annually and the new line will cost $29,000.

MEETINGS

American Society of Heating and Ventilating Engineers—Annual meeting, Muehlebach Hotel, Kansas City, Mo., January 27-29. A. V. Hutchinson, secretary, 51 Madison Avenue, New York, N. Y.

American Institute of Electrical Engineers—Winter convention, Philadelphia, Pa., January 27-31. H. H. Henline, national secretary, 33 West 39th St., New York, N. Y.

Edison Electric Institute—Electrical equipment committee, Statler Hotel, Detroit, Mich., February 10-12; transmission and distribution committee, Statler Hotel, Detroit, February 17-19. Major H. S. Bennion, managing director, 420 Lexington Avenue, New York, N. Y.

American Institute of Mining and Metallurgical Engineers—Annual meeting, Institute headquarters, New York, February 17-20. A. H. Parsons, secretary, 29 West 39th Street, New York, N. Y.

National Electrical Manufacturers Association—Winter meeting, Palmer House, Chicago, Ill., February 17-21. W. J. Donald, managing director, 155 East 44th Street, New York, N. Y.

Oklahoma Utilities Association—Annual convention, Tulsa, Okla., March 17-18. Kate A. Niblack, secretary, 625-626 Biltmore Hotel, Oklahoma City, Okla.

Northwest Electric Light and Power Association—Annual meeting, Business Development Section, Davenport Hotel, Spokane, Wash., March 27-29. Daryl B. Leonard, chairman, Pacific Power & Light Co., Yakima.

American Society of Mechanical Engineers—Spring meeting, Atlanta, Ga., April 1-3. C. E. Davies, national secretary, 29 West 39th St., New York, N. Y.

Midwest Power Conference—Fourth annual meeting, Palmer House, Chicago, Ill., April 9-10. Charles N. Nash, conference secretary, Illinois Institute of Technology, 3300 Federal St., Chicago, Ill.

Electrochemical Society—Spring meeting, Cleveland, Ohio, April 16-19. Colin G. Fink, secretary, Columbia University, New York, N. Y.

Missouri Association of Public Utilities—Annual convention, Elms Hotel, Excelsior Springs, Mo., April 23-25. Jesse Blythe, assistant secretary, Merchants Bank Bldg., 101 West High St., Jefferson City, Mo.

Boston Edison Starts New Plant in Spring

Construction will begin this spring on a new tidewater steam-generating plant of the Boston Edison Co. at a site in Everett in anticipation of a growth in load due to national defense activities. The new station will house at the outset a 40,000-kw. turbo-generator and a 1,200-lb., 900-deg. boiler with auxiliaries, orders for which were placed last summer on a 1942 delivery basis. The plant will be built on the shore of the Mystic River, and with the necessary transmission lines from the station will greatly increase the strength of the Edison system in the northern part of the Boston area.

While ample space remains in the company's Edgar and L Street stations for the installation of additional generating capacity, experience abroad points to the desirability of providing separate units for future development rather than extremely large concentrations, on account of the bombing hazard. This guided the Boston company in its decision toward greater decentralization of power supply.

Work is already in progress at L Street for the installation of an 18,000-kw. topping turbine ordered last summer for delivery early in 1942. With the completion of these two projects the company will have available about 350,000 kw. of modernized capacity, and another 100,000 kw. in reserve to meet emergencies or unusual peak demands.

•

Pittsburgh A.I.E.E. Meet Draws Record Attendance

The midwinter dinner meeting and student branch conference of the Pittsburgh section of the American Institute of Electrical Engineers and the electrical section of the Engineers Society of Western Pennsylvania, held in Pittsburgh last week, drew an attendance of 292, of which 95 were student members, a record.

Dr. Royal W. Sorensen, president of A.I.E.E., discussed early engineering work and the varied and unusual uses of electricity today in other branches of engineering. A.I.E.E. Secretary H. H. Henline discussed institute affairs.

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Lamp Sales Higher

During 1940 Georgia Power Co. sold a total of 752,744 Mazda bulbs, 165.21 per cent of quota, and sold 17,244 I.E.S. lamps, 156.76 per cent of quota and 70 per cent ahead of 1939. Bulb sales were up 11 per cent over 1939.

Output Rise over '40 Is Nearly 11%

With a slight gain over the previous week, production of electricity by the electric light and power industry in the week ended January 18 was 2,843,962,000 kw.-hr., 10.6 per cent more than in the corresponding week of last year, according to the Edison Electric Institute. The margin over the previous year was the largest since the week ended August 10, 1940.

Output in the most recent week was 24.2 per cent ahead of the corresponding week of 1939 and it was within 2.3 per cent of last winter's peak. A year ago output was within 2.6 per cent of the previous winter's peak; in 1939, the margin was 3.1 per cent.

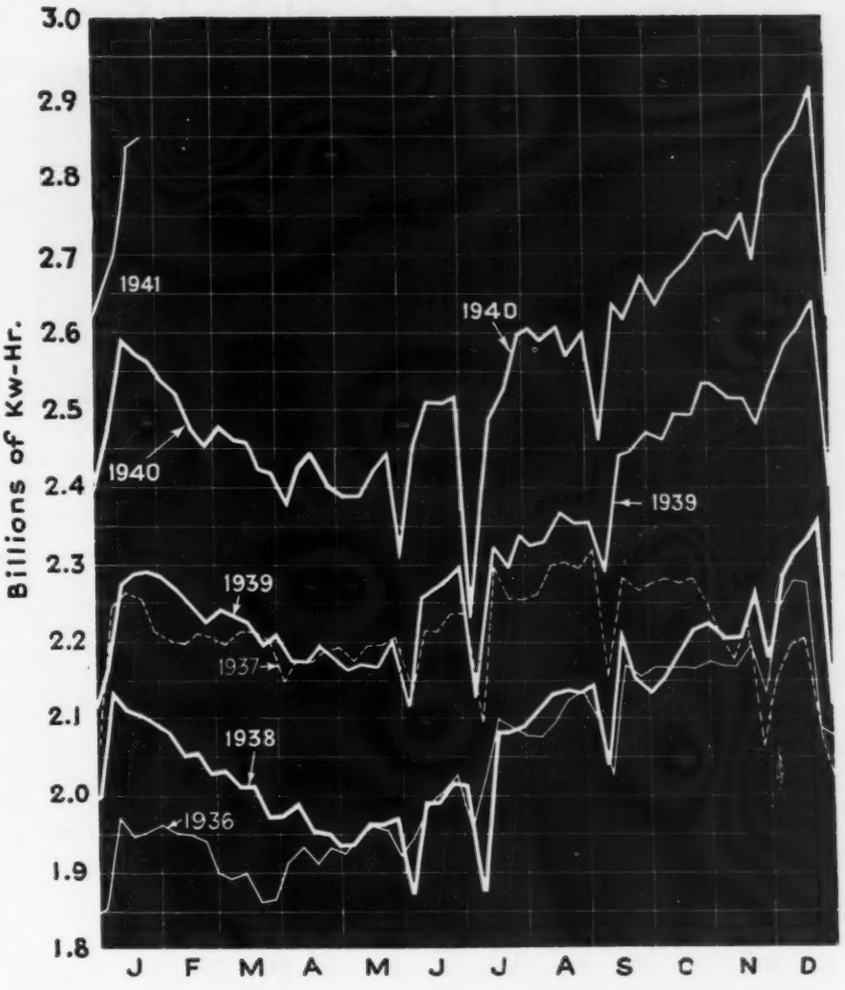
All of the major geographic regions, except the Rocky Mountain, reflected the gain over a year ago by showing increased percentage changes over 1939 in the week ended January 18. The Central Industrial area, which accounts for 31 per cent of the total output, advanced to 14 per cent over a year ago, the largest margin for this section since the week ended August 31, 1940. The New England states showed a percentage rise to 8.6.

Weekly Output, Millions Kw.-Hr.

1941		1940		1939	
Jan. 18	2,844	Jan. 20	2,572	Jan. 21	2,290
Jan. 11	2,835	Jan. 13	2,593	Jan. 14	2,270
Jan. 4	2,705	Jan. 6	2,473	Jan. 7	2,169
1940		1939		1937	
Dec. 28	2,623	Dec. 30	2,404	Jan. 1	1,998
Dec. 21	2,911	Dec. 23	2,641	Dec. 25	2,085
Dec. 14	2,862	Dec. 16	2,605	Dec. 18	2,202
Dec. 7	2,838	Dec. 9	2,586	Dec. 11	2,196
Nov. 30	2,796	Dec. 2	2,539	Dec. 4	2,153
Nov. 23	2,695	Nov. 25	2,482	Nov. 27	2,065

Per cent Change from Previous Year

	Week Ending		
	Jan. 18	Jan. 11	Jan. 4
New England	+ 8.6	+ 7.4	+ 6.1
Middle Atlantic	+ 9.2	+ 7.5	+ 7.2
Central Industrial	+14.0	+12.9	+11.6
West Central	+ 9.0	+ 5.7	+ 7.2
Southern States	+ 8.6	+ 6.7	+ 9.3
Rocky Mountain	+ 7.3	+ 8.1	+ 8.2
Pacific	+ 7.4	+ 7.0	+ 5.2
United States	+10.6	+ 9.3	+ 9.4



Electricity Output Up 9% in November

Production of electric energy for public use during November amounted to 12,501,262,000 kw.-hr., a gain of 9.1 per cent over the corresponding month of 1939, according to the Federal Power Commission. For the twelve months ended November 30 output totaled 140,914,000,000 kw.-hr., or 11 per cent more than in the previous year.

Of the total production during November, 32 per cent was produced by water power, as compared with 28 per cent in October and 28 per cent in November of 1939. The average daily production reached an all-time high for the second consecutive month in November, according to the FPC, when it averaged 416,709,000 kw.-hr., 0.8 per cent more than the average daily production in October.

Reports received during December indicated that the capacity of generating plants in service on November 30 totaled 41,448,699 kw., an increase of 163,035 kw. over the previously reported total.

Electric utility power plants consumed approximately 4,799,987 tons of coal in November, of which 4,580,461 tons were bituminous and 219,526 tons were anthracite, decreases of 5.2 per cent and 6.3 per cent, respectively, when compared with the previous month.

•

Toledo Edison Denies Request for Rate Cut

Toledo Edison Co. has denied requests of local industries, led by Electric Auto-Lite Co. and Spicer Manufacturing Corp., for a 20 per cent reduction in power rates. The utility answered that the business situation is now too clouded by rising taxes, higher fuel costs and higher labor costs to justify such a reduction.

Supports War Efforts

"Winnipeg Electric Co.'s electric, transportation and gas utilities, by continuing to co-operate in the war effort along with other essential industries, will continue to benefit from the resulting increased industrial and military activity in the territory its serves." This is the opinion of W. H. Carter, president of Winnipeg Electric Co. Mr. Carter added: "While much of the increased revenues will be absorbed in higher cost of materials and increased taxes, our view is we have reason to be encouraged."

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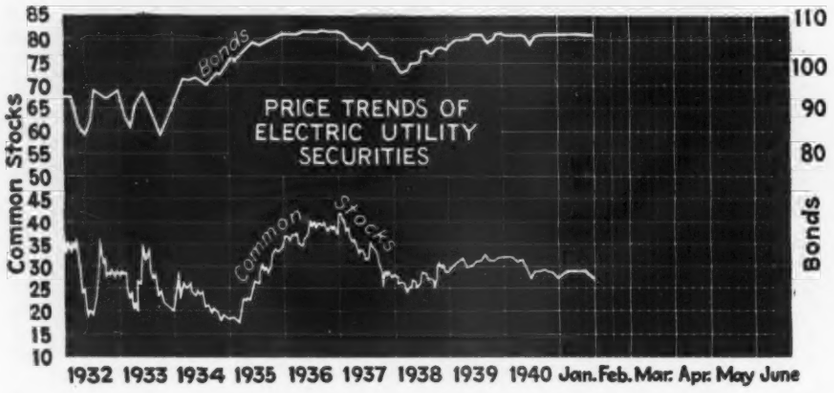
Averts Utility Strike

A strike was averted last week when the union and Narragansett Electric Co. agreed to arbitrate differences. The agreement came less than four hours before union employees were scheduled to strike.

Utility Stocks Lose Ground; Bonds Firm


PRICE TRENDS OF
ELECTRIC UTILITY
SECURITIES
Bonds
Common Stocks
Common Stocks
Bonds
85 80 75 70 65 60 55 50 45 40 35 30 25 20 15 10
110 100 90 80
1932 1933 1934 1935 1936 1937 1938 1939 1940 Jan. Feb. Mar. Apr. May June

The downward trend of electric light and power stocks continued during the past week. "Electrical World" index, 26.8; last week, 27.1; last year 32.1. Changes in the bond list were unsubstantial, the "Electrical World" bond index remaining unchanged at 106.4.

Ordered to Cancel Two Stock Classes

Securities and Exchange Commission has ordered the surrender and cancellation of the class B and common stocks of the International Hydro-Electric system.

The stock now is held by three trustees, Joseph B. Ely, C. Brooks Stevens and Henry G. Wells, for the benefit of International Paper Co. and International Paper & Power Co. The SEC rejected a request by these two companies that the class B and common stocks of Hydro be sold at public auction.

The SEC held that these two classes of stocks are worthless and ordered the trustees to surrender them to Hydro for not more than $1. It also ordered Hydro to accept the stock and to cancel it. Voting control of Hydro will pass to holders of the preferred and class A stocks, of which there are 144,799 shares and 858,197 shares, respectively, outstanding.

Surrender of the stock and termination of the trusteeship, the SEC said in an unanimous opinion, are necessary not only to bring about an equitable distribution of voting control but also to simplify the corporate structure of Hydro.

The commission reserved for future decision the question of whether Hydro itself must make further security adjustments to comply with section 11 B 2.

•

International Utilities Will Pay on Preferred

International Utilities Corp. has announced that the Securities and Exchange Commission had approved the payment out of capital surplus of the quarterly dividend of 87½ cents a share of the company's $3.50 prior-preferred stock. The dividend is payable on February 1 to stock of record on January 20.

The company said that the SEC had reserved jurisdiction in respect to the dividend of $1.81¼ on account of accumulations on the $1.75 preferred stock.

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Utility Petitions Filed with Board

Wisconsin Public Service Corp. has filed a registration statement with the SEC covering the issue of $26,500,000 of 3¼ per cent first-mortgage bonds, due in 1971, and 132,000 shares of 5 per cent cumulative preferred stock of $100 par value (ELECTRICAL WORLD, January 18, page 20).

The public utility also filed a declaration and an application under the Holding Company Act relative to the issuance and sale of the bonds and preferred stock and the sale of 200,000 shares of common stock of $10 par value to the Standard Gas & Electric Co., parent company, at par.

Central Ohio Light & Power Co., Findlay, has filed an application regarding the proposed issuance and sale of $400,000 of 3½ per cent first mortgage bonds, series D, due March 1, 1966, and 1,000 shares of $6 cumulative preferred stock, no par value. The bonds are to be sold, at the principal amount, to the John Hancock Mutual Life Insurance Co. and the preferred stock at $99.50 a share to Modern Woodmen of America, Rock Island, Ill. Proceeds will be applied to the construction cost of an addition to the company's Woodcock electric generating station at Bluffton, Ohio, and the installation at the station of a 7,500-kw. steam turbo-generating unit, a 90,000-lb.-per-hour boiler, and auxiliary mechanical and electrical equipment, and to other improvements to the company's plant and property.

Hearing has been set for February 3 on the application of Toledo Light & Power Co. for an order declaring that it has ceased to be a holding company. The application states that the company has disposed of all of its assets and has been dissolved.

Texas-New Mexico Utilities Co. and Southwestern Electric Co., subsidiaries of Community Power & Light Co., have filed regarding the purchase by Texas-New Mexico Utilities Co. from Southwestern Electric Co. for cash, at the face amount thereof plus accrued interest of $20,600 principal amount of general mortgage bonds, series A, 5 per cent of New Mexico Utilities Co. (assumed by Texas-New Mexico Utilities Co.). SEC has permitted the declaration to become effective.

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Arm's-Length Bargaining Hearing Set by SEC

Securities and Exchange Commission has announced that a public conference will be held on January 27 on the report of the staff of the Public Utilities Division with respect to the maintenance of arm's-length bargaining and competitive conditions in the sale and distribution of securities of registered public utility holding companies and their subsidiaries, and on the staff's recommended competitive bidding rule.

The commission extended to January 24 the date specified for submission of written comment on the report of the staff and on its recommended rule.

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SEC Approves Bank Loan

SEC has issued an order permitting Monongahela West Penn Public Service Co.'s declaration regarding a proposal to borrow not more than $800,000 from the National City Bank, New York, to construct transmission lines and substations.

Utility Reports

	Net Income 1940	1939
*Birmingham Electric	$486,477	$618,302
*California Oregon Pwr.	943,724	896,343
*El Paso Electric	445,035	376,458
*Electric Power & Light and subs.	6,489,031	4,335,769
*Key West Electric	46,786	39,316
*Northwestern Electric	473,236	584,765
*Oklahoma Gas & Electric	2,639,483	2,850,801
†Public Service of N. J. and subs.	23,188,425	25,722,729
*Savannah Electric & Power	153,765	250,727
*Superior Water, Lt. & Pwr.	110,318	120,075
*Western Public Service and subs.	180,757	171,819

* Twelve months ended November 30.
† Twelve months ended December 31

OPERATING PRACTICES

Handling Unbalanced Transformer Loads

By BERTRAM E. ELLSWORTH
Electrical Engineer
Iowa-Nebraska Light & Power Company,
Lincoln, Neb.

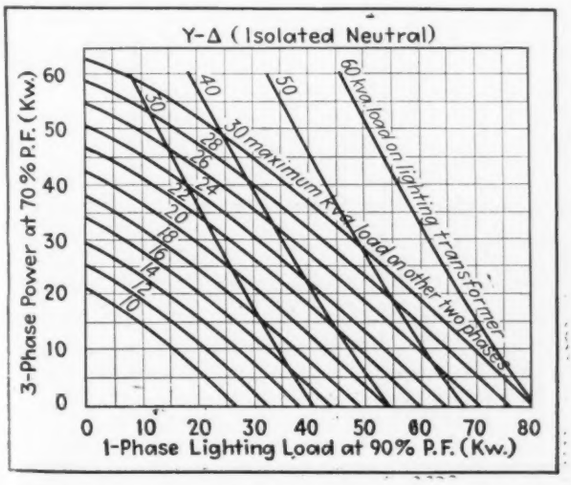
Some transformer connections lend themselves to unbalanced loads much better than others. Where the single-phase lighting load is high with respect to the three-phase power load perhaps the best connection is the open delta. With the open delta the lighting load is carried by the lighting transformer alone and does not load the other transformer. Curves for this connection are shown in the March 25, 1939, issue of ELECTRICAL WORLD, page 70.

Where light and power loads are about equal the closed delta connection is good. If all three transformers are the same size, two-thirds of the lighting load will be carried by the transformer on the one phase to which this light load is connected. Usually the transformer on the lighting phase is larger than the rest and more than two-thirds of the load is carried by it. The division of load for the closed delta bank is shown by curves in the February 25, 1939, issue of ELECTRICAL WORLD, page 78.

The Y-delta connection with the neutral isolated is a very poor connection to use with combination loads. Two-thirds of the load is carried by the transformer on the lighting phase; however, the load carried by one of the other transformers is at a very poor power factor. This loads the one transformer with wattless current affecting heating and regulation. This connection is ordinarily not employed for large combination loads.

The curves showing the operation of the Y-delta bank are given for values ordinarily found in distribution systems. By comparing this curve with the two referred to above it will be noted that the single-phase lighting load quickly loads up the transformer on the two other phases.

As an example, assume 50 kw. lighting at 90 per cent power factor and 20-kw., three-phase power load at 70 per cent power factor are to be carried by a Y-delta bank with isolated neutral. By projecting from these values on the two coordinates a point is determined which indicates that the lighting transformer will carry 47 kva. and the maximum load on one of the two other transformers will be 26.5 kva. From this the size of transformers, one 50 kva. and two 25 kva., can be chosen as being sufficiently large for the load.



OPERATION of a Y-delta bank under unbalanced loads

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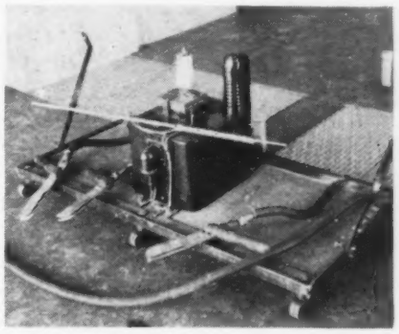
Portable Bus Grounds Outgoing Feeders

At the Fort Worth plant of the Texas Electric Service Company operators have devised a handy "portable ground bus" which they use in the switch house for "grounding out" the line side of feeder disconnect switches opened to protect men working on that circuit inside and outside the plant.



MOBILE "bus" used to ground the line side of feeder disconnect switches in Texas plant

Transformer and voltmeter are for checking potential before applying ground.

The device, which is shown in the accompanying illustration, not only effectively grounds the feeder circuit inside the plant but is connected to the feeder disconnect switch clips in such a way that the switch cannot be closed until the ground has been removed. Also, since the grounding device extends across the front of the switch compartment and is held

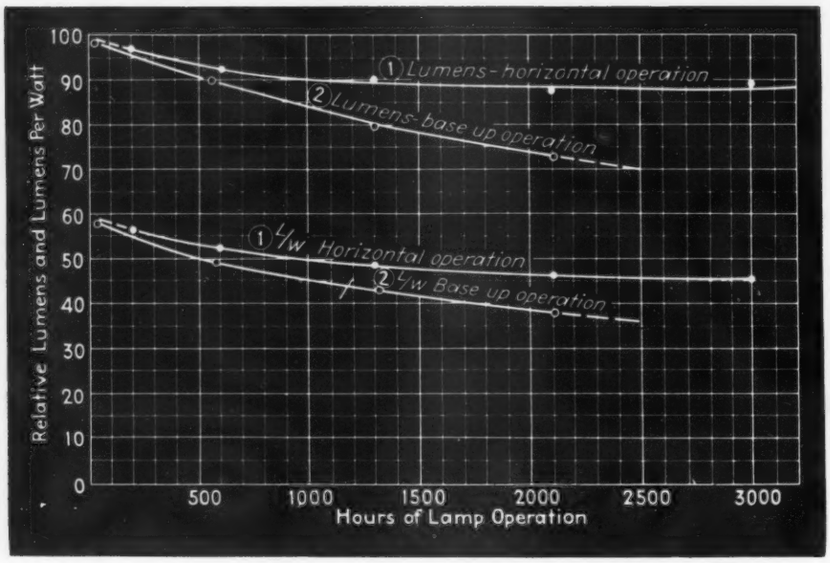


CHART of lumen maintenance of 1,000-lumen sodium lamps designed for universal burning shows increased lumens and lumens per watt obtained from horizontal position as against vertical position

in place by compartment cover bolts, it forms an effective safety barrier.

As may be seen, the "portable ground bus" consists of a 1½ x 4-ft. tray mounted on casters for mobility. The tray is provided with a single copper strap to which a long, flexible grounding cable is attached. Three shorter cables, also attached to the ground strap or "bus," are each provided with clip connectors mating with the clips on the feeder disconnect switches. A potential transformer and voltmeter, with one side connected to the grounded strap and the other attached to a feeler, provide operators with a ready means for determining if the switch terminals are alive before entering the switch compartment.

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Burning Positions of Sodium Lamps

By H. A. BREEDING
Physicist, General Electric Lighting Division, Schenectady, N. Y.

Tests on General Electric sodium lamps designed for universal operation—that is, in either a horizontal or vertical operation—have shown that lamps burned in a horizontal position depreciated about 10 per cent in lumen output during the first third of their rated average laboratory life. However, after this initial depreciation, the lumen output remained almost constant during the ensuing 2,000 hours. In sharp contrast, lamps burned in a vertical base-up position showed a continuous drop in lumen output over their entire life.

Furthermore, whereas 234 horizontally operated lamps showed an average life of 2,886 hours, 48 lamps in a base-up position showed an average life of only 2,211 hours.

There is a visual difference between the lamps operated in the two positions which gives us a clue for the better performance of those lamps which are operated horizontally. The condensed excess sodium will accumulate on the coldest spot in the lamp. In a horizontally operated lamp that sodium spot is on the bottom of the lamp about half way between the two electrodes. In a lamp operated vertically base-up, the sodium spot accumulates close to the tip end of the lamp, which is detrimental as far as light output and life of the lamp are concerned.

In addition to more constant lumen maintenance and better life obtained by operating the universal type sodium lamp in a horizontal position, the additional advantage of the very simple reflector required to produce uniform brightness on the street must also be recognized.

The reader should remember that there are sodium lamps designed for vertical base-up operation and others designed for universal operation. The data presented in the accompanying chart apply only to lamps designed for universal burning.

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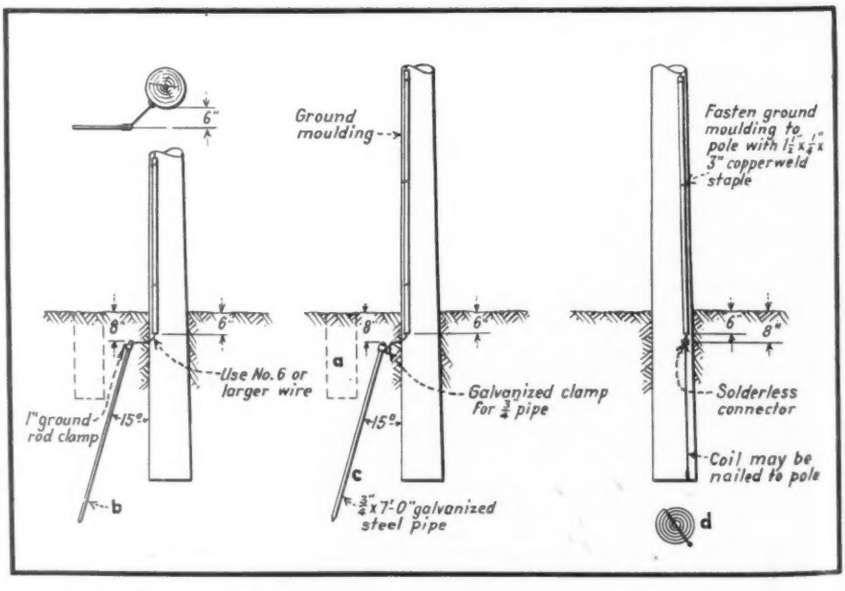
West Penn Standard Ground Connections

For their standards this company states that top of rod, pipe or connector shall be 8 in. below ground line. Ground molding shall extend 6 in. below the ground line. Back-fill around connector or top of rod shall be free from cinders and slag. To drive pipe use ⅝ x 12-in. through-bolt and 2¼ x 2¼-in. square washer as driving cap. Flatten other end of pipe for driving point.

(a) If resistance is above 25 ohms bury 75 lb. of rock salt. (Do not bury salt in contact with rod or pipe.)

(b) To be used only in locations



CROUND connection standards of West Penn Company

affected by mine or factory drainage near slag dumps or cinder fills.

(c) To be used where copper-covered rod is not required.

(d) Coil made from No. 2 or No. 0 scrap copper wire. To be used where possible instead of rod or pipe.

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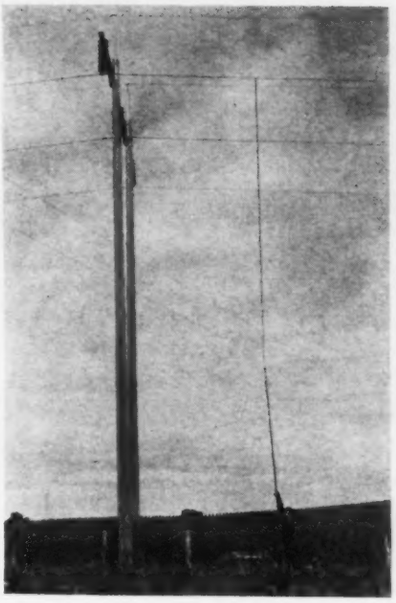
Field Measurement of Line Clearances

By VERNON W. PALEN
Northern States Power Company (Wis.), Eau Claire, Wis.

A considerable amount of clearance measurement work, involving cases where lines of the Northern States Power Company (Wis.) passed over telephone or REA lines, indicated the need for a quick, yet accurate, method of getting the desired measurements. The accompanying illustrations show the method of measuring clearances employed by company engineers.

Equipment consists of a standard 12-ft. "hot stick," two bamboo fishpoles, friction tape and rubber gloves. The light poles are fastened to the hot stick to form a measuring stick of known length, which can be raised by the operator (wearing rubber gloves) till the tip is at the elevation of the line conductors. Distance from the ground to the butt end of the hot stick is measured, using a non-metallic tape. This measurement and the length of the "feeler" give the height of the conductor. The same procedure is followed with the lower line; the difference in the two heights gives the line clearance.



GLOVED OPERATOR determines line clearance using hot stick and bamboo poles of known length. This is a 120-kv. line

Care should be exercised in making measurements to prevent contact of both lines at one time with the fishpole, since a flashover might result if it is not perfectly dry. It is best to make measurements on hot, dry days.

One disadvantage of the fishpole arrangement is that on 40-ft. heights the poles bend badly, since the butt of the top fishpole adds excessive weight at a point high above the ground. The 120-kv. line in the illustration was 42 ft. above ground, and in such cases a hook is taped to the end of the pole and "caught" over the conductor. The purpose of the hook mentioned is to allow the measuring rod to hang straight while measurements are being made. Where lines are not more than 30 to 35 ft. from the ground the poles will support their weight upright, making it unnecessary to use a hook to support the pole from the line conductor.

It is the opinion of the author that there would be a ready market for a properly insulated light, hollow pole of bamboo or fiber about 40 ft. in length which could be disassembled into four 10-ft. lengths. It would, of course, have to be insulated for use on voltages up to 120 kv.

A form, shown herewith, has been developed for recording crossing data. Where clearances are found inadequate, owners of the newer line are notified that the crossing does not comply with the code requirements.

Foreign Line Crossing Record

Draw arrow head in direction of North

Crossing No. _____

Foreign Line

Distance AX _____ Ft.
Distance BX _____ Ft.

Voltage NSP Line _____ Volts ___ Phase
Voltage REA Line _____ Volts ___ Phase

Note that distances to be measured are from crossing (X) to nearest pole on each line

A

B

X

NSP Co. Line

NSP Pole No. ___

NSP Pole No. ___

A + B = 100 ft. or less-use basic clearance. If over, increase basic clearance 1/10 ft. for each 10 ft. of excess to a maximum of 2.5 ft. of additional clearance

At Point X Height Above Ground of

Foreign Line _____ Ft.
NSP Co. Line _____ Ft.
* Clearance _____ Ft.
Temperature _____ Degrees F.

Basic Clearances

Upper Line	Lower Line: 0 to 7,500	Lower Line: 7,500 to 50,000
750 to 7,500	2 ft.	
7,500 to 50,000	4 ft.	4 ft.
69,000	4 ft.-10 in.	4 ft.-10 in.
120,000	6 ft.-11 in.	6 ft.-11 in.

Section No. _____ Township No. ___ North
Range No. _____ County _____

* By Subtraction

FORM used for recording clearance data for line crossings

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Costs of System Improvements

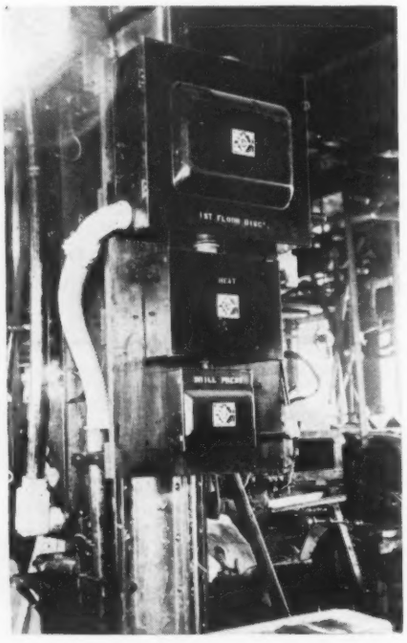
From the data sheets of an Eastern utility filed with its regulating commission are given the following summarized costs of typical improvements recently completed or far enough along to add value to engineering department estimates on these undertakings:

Installation of a 40,000-kw. turbine unit with boiler equipment, fuel-handling facilities and miscellaneous electrical facilities	$3,755,500
Substation extension with 11-kv. and 110-kv. switching, on above plant property	481,200
Installation of a 15,000-kva. transformer and relays for 22-kv. feeder service	43,100
Installation of 30,000-kva. transformer capacity, with miscellaneous electrical equipment at a 66-kv. substation	93,320
Installation of three 667-kva. transformers at outlying substation	9,400
Provision of totalizing and dispatcher's metering facilities for three "high" lines (one 110 kv., two 66 kv.) at dispatcher's office	1,424
Addition of three 1,667-kva. transformers to suburban substation	11,844
Addition of one 833-kva. transformer to suburban substation	3,077
Addition of three 1,000-kva. transformers at industrial substation	10,829
Construction of single circuit 110-kv., No. 4-0 pole line between terminals about 11 miles apart, including rights-of-way, land, poles, etc.	309,904
Installation of two 40,000-kva. transformers at a step-down station, converting 110 kv. to 11 kv.	301,167
Provision of a second 7,500-kva. transformer bank, 33 kv. to 11 kv., in an outlying substation	22,035
Construction of substation facilities, three 220-kva. transformers to serve an airport	3,800

INDUSTRIAL ENGINEERING

Power Control From Upper Floor

To improve the sectionalization of power supply at its plant bordering the Connecticut River the Colt Patent Fire Arms Manufacturing Company, Hartford, decided after a recent flood to establish main control circuit breakers for an important department on the first floor in a location on the floor above. This enables all motors in the group to be cut out of service at a single hand-operated 200-amp. Noark switch located on a central column on the second floor in case of high water or other necessity.



INDUSTRIAL MOTORS supplied from above flood level

Continued operation of machinery on other floors above the water level would in such case be independent of conditions on the lower floor, since the condition of motors, control apparatus and 220-volt supply circuits in the lower part of the plant would not cause trouble above from local short circuits or grounds. The motor group feeder is run in 2½-in. conduit from the sectionalizing switch and there are four of these breakers in the department, all situated at least a story above the previous high water mark.

•

Focusing Reflectors in Infra-Red Tunnel

Design of the 189-kw. cylindrical, infra-red tunnel installed last June in the enameling department of the Dayton, Ohio, works of the National Cash Register Company is significant. Its significance, however, does not lie in anything new about the application—drying enamel on cash register cabinets—nor does it lie alone in the elimination of a production bottleneck, although the company states that it does a job in seven minutes that formerly took 1½ hours at 225 deg. in a steam oven. This particular tunnel design is significant because it is among the first—if not the first—in which deep reflectors were used that allowed infra-red rays to be focused (or diffused) to obtain a degree of temperature control on the surfaces of a complex object.

The 50-ft. NCR tunnel is divided into nine longitudinal sections. Each section consists of 84 tungsten filament lamps (250-watt) mounted on a cylindrical support frame and arranged in fourteen rows of six lamps each around the inner circumference of frame, as shown. Rows of reflectors are staggered slightly to conserve space. Diameter of the tunnel from rim to rim of the reflectors is 40½ in. Outside diameter of the supporting frame is 66 in. For convenience in relamping, the frame is divided into two parts longitudinally and each half is supported in such a way that it can be swung out at the bottom to permit a man to walk inside the tunnel. The conveyor which carries parts through the tunnel travels at 7 ft. per minute.

Reflectors used in this tunnel were designed by the National Cash Register Company and manufactured by the Dayton Manufacturing Company. In appearance they somewhat resemble conventional high-bay lighting units, being 10 in. in diameter at the rim and 8 in. deep. When in focus the lamp filament is 5¾ in. from the rim. Under this condition a substantially uniform cross-hatched pattern is secured at a point 10 in. out from the reflector. At the 12-in. point energy concentration is 2.8 watts per sq.in. The effect of throwing a bank of reflectors out of focus (moving the filament nearer to the rim) is to reduce temperature on surfaces near the lamp and increase the temperature of surfaces beyond the 10-in. point.

Lamps in the first 8 ft. of this tunnel are adjusted to be in focus and thus bring the work up to temperature as rapidly as possible. From the 8-ft. point to the end of the tunnel reflectors are out of focus. This has the effect of increasing temperature on planes parallel to the reflector axis and keeping down the temperature on points "facing" the reflector. The result is more uniform temperature distribution on the product. The top and bottom two rows of reflectors throughout the tunnel are in focus, however, to avoid hot spots which developed. Temperatures on

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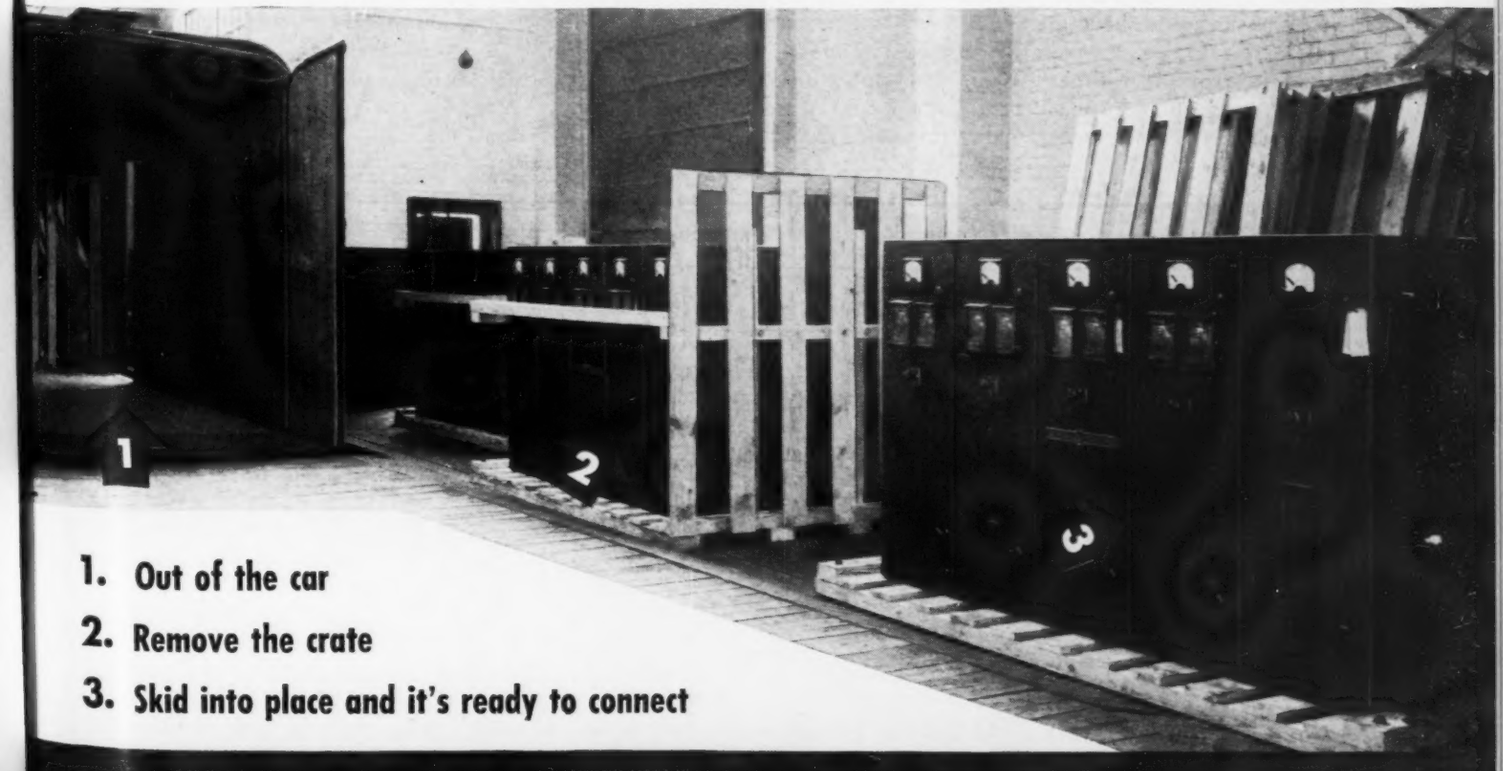
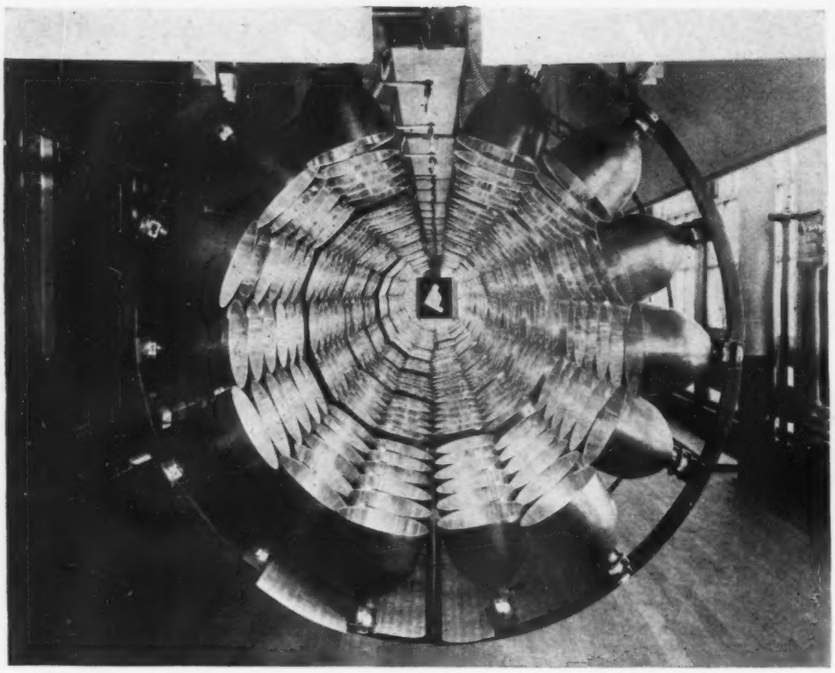


1. **Out of the car**
2. **Remove the crate**
3. **Skid into place and it's ready to connect**

GENERAL ELECTRIC

854-11



SPECIALLY DESIGNED, deep-bowl focusing reflectors in infra-red tunnel keep temperature on various surfaces of individual cash register cabinets within 80 deg. range. View taken at discharge end of tunnel looking toward entrance. Tunnel capacity 189 kw., length 50 ft., conveyor speed 7 ft. per minute

various cabinet surfaces, as measured by thermocouples, on the panels are shown in the accompanying curves. It is to be noted that the maximum temperature spread between any two surfaces on the same cabinet is approximately 80 deg. and that the maximum temperature attained by any cabinet surface is about 435 deg., the minimum 355 deg.

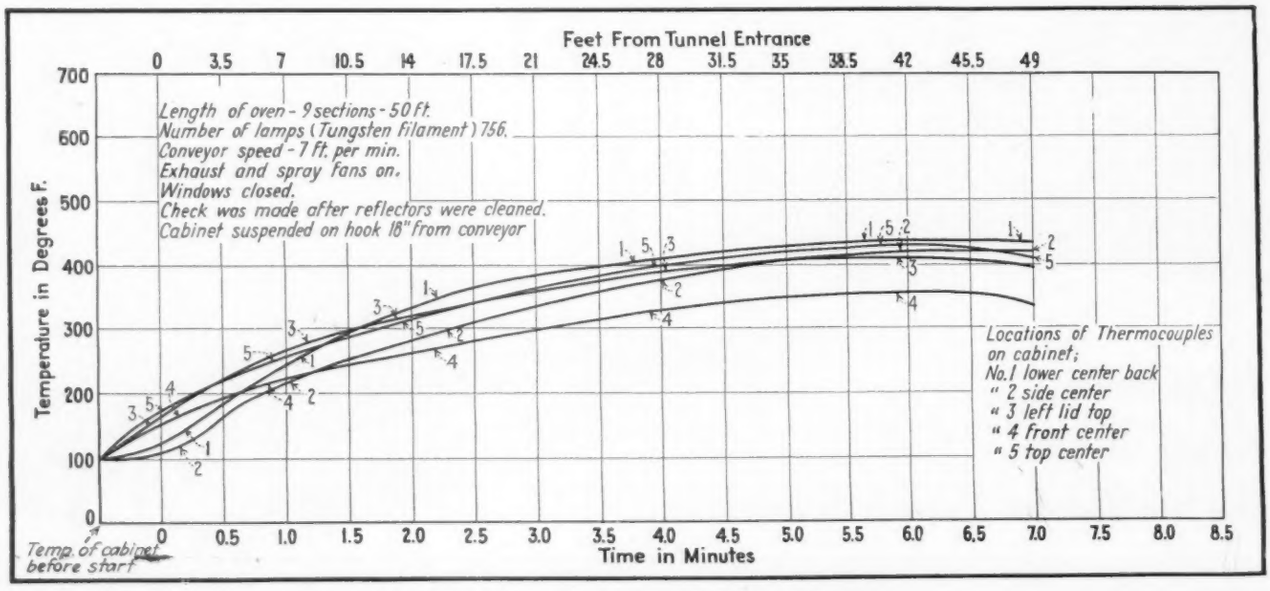
Initial experiments with infra-red drying at this plant were made in a horseshoe-shaped tunnel, using shallow reflectors. The large cross-section of this tunnel and inability to focus the reflectors made it impossible to attain the temperatures needed. Change to the circular tunnel section reduced the cross-sectional area and the design of the deep, focusing reflector brought better temperature distribution. With all 756 lamps in focus in the present tunnel a temperature of 630 deg. is said to be attainable on a single straight panel suspended from the conveyor.

CO_2 Facilities Cut Electrical Fire Loss

Provision of CO_2 fire-fighting facilities for early use in industrial oven locations is proved by recent experience to form a useful means of cutting down fire losses in case of trouble. In a typical case employees in a machine tool plant handling important defense production detected smoke coming from an electric oven, which, in connection with overtime work the night before, had been loaded with varnish-dipped coils. Shortly after the oven was switched into circuit the thermostat control developed trouble and built up maximum internal temperature. A watchman was on duty, but his instructions only provided for switching off ovens after individual units had been in operation for a specified time. Eventually the varnish on the coils was ignited.

Discovery of the smoke led to the closure of the ventilating doors in the oven bottom, and with these maintained in this position carbon dioxide gas was discharged into the oven through the ventilator and the fire was extinguished with a loss of but $500.

The analysis of the fire by the Factory Mutual engineering department indicated the importance of frequent inspection of thermostatic controls and improvement of instructions to watchmen. Availability of CO_2 equipment was a major factor in keeping down the loss.


Feet From Tunnel Entrance
0 3.5 7 10.5 14 17.5 21 24.5 28 31.5 35 38.5 42 45.5 49
Temperature in Degrees F.
700 600 500 400 300 200 100 0
Length of oven - 9 sections - 50 ft.
Number of lamps (Tungsten Filament) 756.
Conveyor speed - 7 ft. per min.
Exhaust and spray fans on.
Windows closed.
Check was made after reflectors were cleaned.
Cabinet suspended on hook 18" from conveyor
Locations of Thermocouples on cabinet;
No. 1 lower center back
" 2 side center
" 3 left lid top
" 4 front center
" 5 top center
Temp. of cabinet before start
0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0 6.5 7.0 7.5 8.0 8.5
Time in Minutes

CURVE of panel temperatures on cash register cabinet passing through infra-red tunnel

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GENERAL ELECTRIC

NEW ENGINEERING IDEAS

Relay Protects Bus with Feeder Reactors

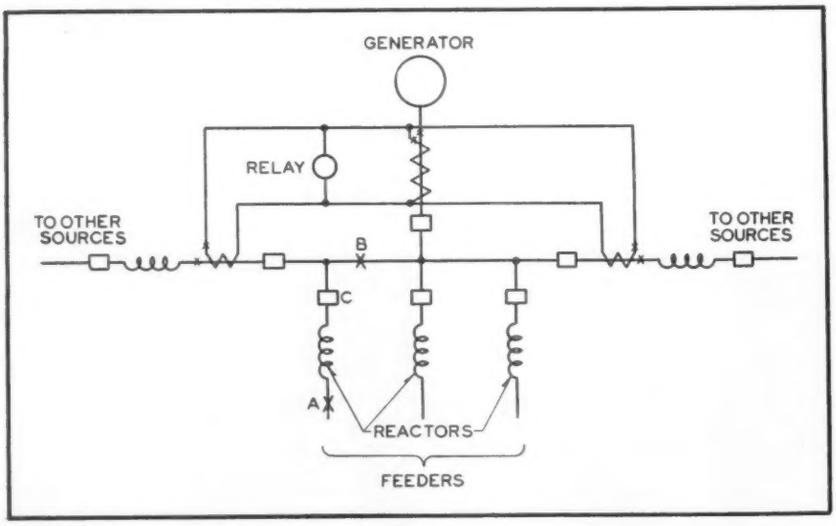
By W. K. SONNEMANN
Relay Engineer Westinghouse Electric & Manufacturing Company, Newark

Conditions in a power plant are not always such that the ideal bus-protection system can be installed. Economics or lack of space to install a complete system of bus-differential transformers at all protection points make it impossible. In the case of a large power station on the Atlantic seaboard feeder reactors had been installed at the points shown in the diagram to limit the fault current.

When this system was studied for a bus-protection scheme it was found that the impedance of the reactors was so close to the ohmic impedance of an arcing fault that the conventional impedance relays might not be able to distinguish between an internal phase-to-ground fault on the bus and one external to it. This was because the system was grounded through a resistor, thus limiting the ground-fault current and increasing the resistance of an arcing fault. In other words, an arcing ground at point B might appear to the relay like a solid fault at *A* (which should be cleared by breaker *C* alone) and would not trip all the bus-section breakers.

It was necessary to provide the bus-protection relay with some additional means of discrimination for internal and external faults. This was accomplished by modifying the relay so that it takes note of the phase angle of the current, as well as its magnitude and direction. Advantage was taken of the fact that the voltage drop across an arc is largely a resistance drop, whereas a short circuit through a reactor provides a voltage drop which is almost wholly reactive. Thus, the relay was modified to make it more sensitive for in-phase faults, such as an arcing line-to-ground fault on the bus, and relatively less sensitive to highly lagging currents, which would be obtained on faults beyond a reactor.

Phase sensitivity of the relay was accomplished by adding a voltage coil fed through a condenser on the same magnetic circuit as the current coil. A modified reactance relay was thus secured, as first described by Goldsborough and Lewis in a paper presented before the A.I.E.E. mid-winter convention, January, 1932. It was necessary to utilize an overcurrent fault detector relay connected in the residual circuit in order that the scheme would be unaffected by normal load currents.



GROUND PROTECTION for a bus equipped with low-reactance feeder reactors

Demand Meter Yields Accurate Record

By EARL L. HURT
Public Service Company of Northern Illinois, Northbrook, Ill.

An attachment for conventional graphometers or recording wattmeters, commonly employed for measuring industrial kilowatt demand, has been evolved at the meter shop of the Public Service Company of Northern Illinois. The device changes the character of the record produced by the instrument stylus. Instead of drawing a continuous line on a wax-coated chart of a length proportional to demand, the modified instrument produces a line of dots, each dot representing a contact operation or increment of demand. Since the dots can be counted readily, if they do not coincide with the chart scale, the problem of accurate zero

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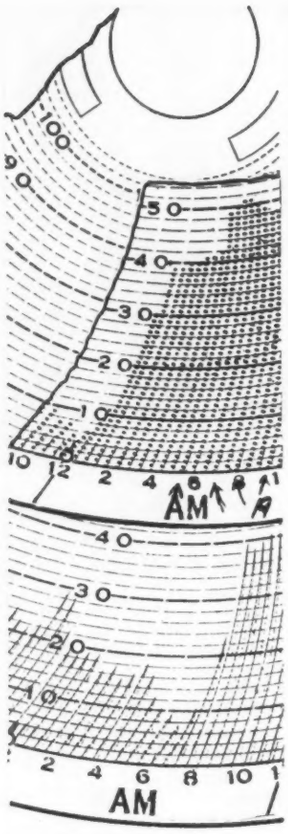

RECORD MADE by modified recording demand meter consists of line of dots, each dot representing a contact operation

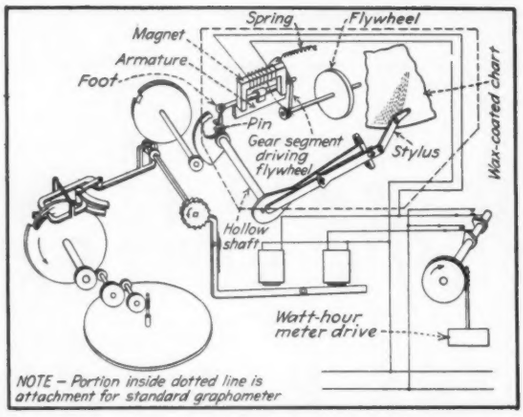

DIAGRAM of modified graphometer mechanism which can be added to all but duplex instruments

Immediately a contact is made by the brushes on the watt-hour meter the recording stylus arm is advanced one unit across the chart by the instrument mechanism. Simultaneously, an electromagnet which is connected across this same set of brushes attracts a loosely coupled, shaft-armature. A gear segment attached to one end of this armature shaft spins a tiny flywheel as the armature approaches the magnet pole faces. As the armature reaches the magnet pole face the momentum of the flywheel causes a foot on the opposite end of the armature shaft to deliver a sharp blow to a free pin in the hollow stylus shaft, bringing the stylus point down smartly on the chart to print the dot. With the flywheel energy spent, a coil spring returns the armature shaft far enough to clear the foot and pin, removing the stylus point from the chart. When the electromagnet is de-energized the shaft returns to position ready for the next contact.

Record of line-drawing instrument is shown for comparison. Dots on zero line marked "A" are contact operations occurring during 10-20 second period of inactivity between demand periods.

adjustment, which is so important in the line drawing wattmeter, is eliminated. The scale in the modified instrument is used only as a convenient guide.

The stylus in moving across the chart does not touch it, except momentarily when making a dot, and then only after the stylus has come to rest. Consequently, the revamped instrument is not affected by either whip of the stylus arm or backlash of the gear train. The instrument is no harder to set to zero with this attachment than before; accordingly the same degree of accuracy in zero adjustment can be maintained, if desired, with the added advantage of the chart indicating the exact relation of stylus and chart zeros.

In case chart and stylus zeros do not coincide in the revamped instrument the second dot of any demand period will show this clearly. With coincident zeros the second dot will fall exactly on a chart line. If it does not, its location above or below the line will show the amount the zero is "out." The relationship between the dots and scale marking will remain throughout the demand interval if the stylus arc is properly adjusted. Thus, on a chart of the type shown, the correct reading is obtained by following the row of dots from the bottom upward to the top, visually checking the relations of the dots and scale markings on the chart. If the dots are low all the way up, with respect to scale marks, the peak reading corresponds to the scale point just above the top dot. If they were high the peak reading is the scale point just below the top dot. If there is still doubt, then the dots should be counted.

Contact operations occurring during the 10-20 second period of inactivity of the graphometer between demand periods are recorded on the zero line of the chart with this attachment.

Operation of the rebuilt instrument in recording a contact is shown in the accompanying diagram.

•

Working on New Type Earth-Boring Machine

By RAY BLAIN

Washington, D. C.

Considerable experimenting is being performed with a view to developing an earth-boring machine that will operate from a shaft extension to the regular winch of a line construction truck. Should such a machine prove successful, it would be lighter in weight and should be lower in cost than the commonly used variety of earth-boring machines. It should also be more convenient for spotting at holes, since the truck used for its operation could be driven along the road and need not be backed at right angles to the road for each hole location.

EARTH-BORING MACHINE operating from shaft extension to winch of line truck suggests construction economies. Machine shown built by Highway Trailer Company, Edgerton, Wis.

LOAD BUILDING

Bake Sand Cores for 2 to 4 Mills

Records kept by the Northwestern Motor Company, Eau Claire, Wis., since it converted its two coke-fired core ovens to electric operation reveal an energy consumption rate of 0.223 kw.-hr. per lb. of core sand baked for the larger (48 kw.) of the two ovens. Depending on the unit energy cost, this represents a cost of from 2.2 mills to 4.4 mills per lb. of core sand fired. Thermostatic control of the ovens, to the delight of the core makers, has given a more uniform temperature throughout the oven, with the resulting marked improvement in core quality. Automatic control also relieves the night watchman (cores are baked at night when the plant load is lightest) of more or less constant attendance over the ovens.

The two ovens at this plant are of hollow tile construction with 4 in. of Rockwool insulation separating the inside terra cotta tile from the outside concrete tile which is exposed to the weather. The larger of the two ovens is 12 ft. wide, 14 ft. deep and 8 ft. high. It is heated by twelve 4-kw. assemblies of strip heaters mounted on the walls of the oven a few inches off the floor. Four assemblies are along three walls of oven. All twelve assemblies are connected to the plant 440-volt, three-phase system. A similar arrangement exists in the smaller oven except that nine assemblies are used. This oven is 8 x 14 x 8 ft.

The thermostat controlling oven operation maintains a temperature of 485 to 500 deg., which core makers find most satisfactory. Each day's core production is put in the oven in the late afternoon and the oven started promptly at 4:30, when the rest of the plant shuts down. Temperature is attained usually by 10:30 and the bake continues from two to four hours, depending on the weight of the charge. During a 24-day test period, for example, 66,288 lb. of racks and plates, plus 41,580 lb. of sand, were charged into the 48-kw. oven and a total of 9,290 kw.-hr. was consumed by the oven. These data reveal that the oven actually averaged 387 kw.-hr. per run. In usual operation consumption ranges between 350 and 400 kw.-hr. per run, depending on the weight and thickness of the cores. These data should not be interpreted too freely since the consumption of the ovens will vary with the oven construction. They merely indicate the performance of an oven installation which has produced satisfactory cores at a reasonable cost.

ELECTRIC core baking oven (48 kw.) uses 0.223 kw.-hr. per lb. of sand charged. Twelve 4-kw. heaters (see arrows) displace coke firing and give more uniform bake

•

Cave Lighting Job Yields 17-Kw. Load

By R. W. WILSON
Manager, Commercial Sales
Kentucky Utilities Co., Lexington

Utility lighting engineers have known that for an interesting lighting job the proper illumination of statuary and of church interiors offers a fair assortment of problems. However, where these forms and colors occur in an underground cave the assortment of problems is enlarged.

On U. S. Highway 25E, between Middlesboro, Ky., and Cumberland Gap, Tenn., just below the famed Pinnacle where three states, Kentucky, Virginia and Tennessee, meet, is to be found Cudjo's Cave, one of nature's most beautiful pieces of handiwork. The cave derived its name from a slave known as Cudjo, who deserted his master during the Civil War and hid there, acting as mascot for the soldiers of both the North and the South as the area changed hands.

The electric lighting of this cave

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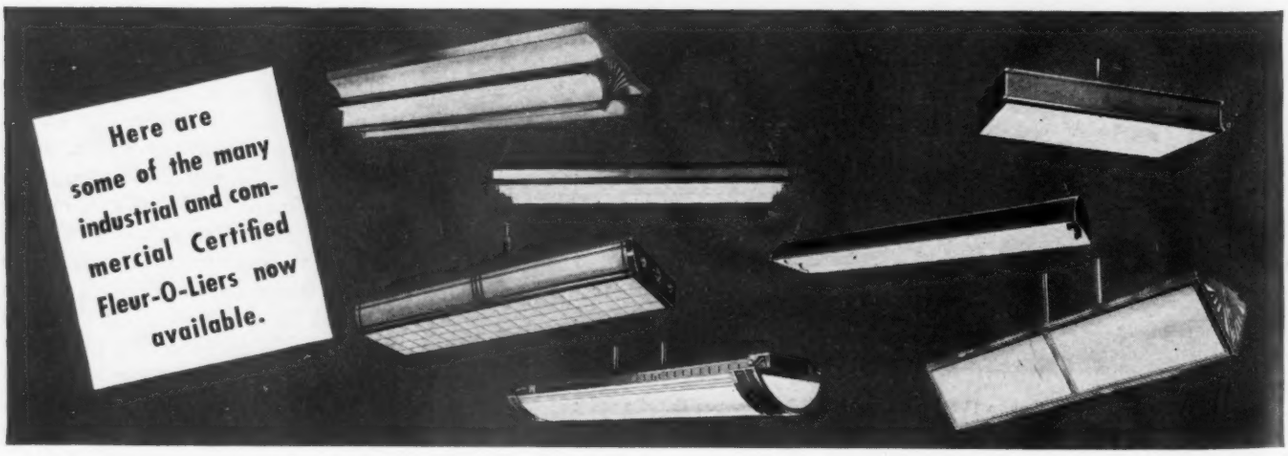

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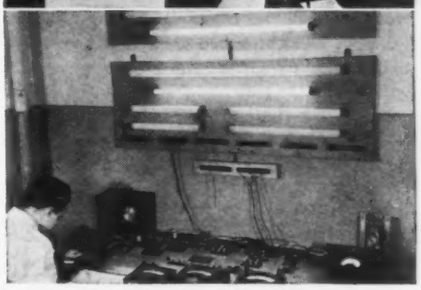

Checking performance of fluorescent lamp ballasts

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FOR CLEOPATRA'S BATH—An underground pool in a Tennessee-Virginia-Kentucky cave, flanked by colored formations ranging from jet black onyx to crystal white, presents rare problems to the lighting engineer

was completed under the engineering direction of Dave Crockett, Kentucky Utilities Company, when hundreds of Mazda lamps of various sizes were placed at intervals through the avenues of the cave to light the pathway of the visitors, and specific floodlighting was applied to all unusual and novel formations so as best to display their beauty and make them easily visible.

For example, "Cleopatra's Bath Tub" is a crystal clear pool of water about 8 ft. in diameter and 3 ft. deep, with a large stalactite of unusual shape and beauty formed in the center. On the sides and rear of the pool clusters of stalactites, stalagmites and draperies of onyx present a natural wonder. Most of the draperies being translucent, the placement of electric lights behind them presented a spectacle of awe-inspiring beauty.

The installation includes 3,000 ft. of No. 6 single-conductor Parkway tellurium cable for main feeder and 6,000 ft. of No. 10 two-conductor Parkway tellurium cable for branch circuits leading to 22 R.L.M. domes, 66 shallow domes, nine symmetrical angle reflectors and some specially made floodlights. Some bare lamps were used in spots where they could be concealed and it all amounts to a connected load of 17,375 watts at present. The operators of the cave plan to add to the lighting further to enhance the splendor of this unusual and beautiful cavern.

•

Develop Continuous Annealing Furnace

By L. M. DURYEE
Connecticut Light & Power Company, Waterbury, Conn.

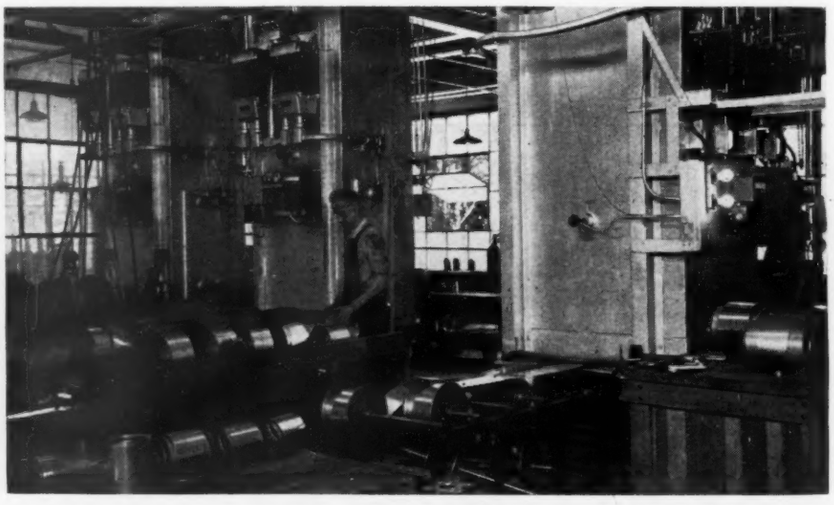
Prior to 1927 the bright annealing of strip nickel was entirely confined to pot type furnaces. Continuous annealing of the strip was impossible at that time and the type of furnace then in use gave results that were far from satisfactory under the exacting standards that apply to the art of annealing metal. Soft and hard spots in the metal resulted, because lack of circulation of the heat in the fuel-fired pots gave non-uniform temperatures. Slow production was, of course, inherent in the use of pot furnaces, unless a large investment in a number of furnaces was made.

In 1927 the Somers Brass Company, Waterbury, Conn., began experimenting, with the thought in mind that electrically heated vertical bright annealing furnaces would anneal their nickel uniformly and continuously. They put their problem in the hands of a competent consultant, for at that time furnace manufacturers were building equipment of more orthodox design. With the help of this expert, the Somers Brass Company developed its own bright annealing furnaces shown in the accompanying illustration. These three furnaces were built in their shop under supervision of both the consultant and the brass company. They were the first continuous electric strip annealing furnaces in existence for the bright annealing of nickel.

Each of these vertical furnaces is 27 ft. high, with a combined total load in the three furnaces of 140 kw. An hourly metal load of 1,200 lb. per hour is annealed here in the form of continuous strip metal. Each furnace is capable of handling three strips of 7-in. wide nickel at one time. The strip is fed into the opening at the bottom, travels to the top, where it is cooled by contact with a water-cooled drum, and travels down to the bottom and out. The brightness of the finish is obtained by both cracked city gas and hydrogen atmosphere.

With these electric furnaces, and with thirteen years of continuous use to give factual results, the Somers company reports on the bright annealing done here as follows: (1) The uniformity of anneal is unexcelled. (2) Brighter metal is obtained with complete elimination of pickling. (3) Greater flexibility results for large or small quantities of metal. (4) Material reduction in maintenance. (The average life of the nickel-chrome elements used is three years of sixteen hours per day operation.)

These electric furnaces, developed and installed at the Somers factory, are now practically standard equipment wherever continuous strip annealing is done.



THIRTEEN YEARS of experimentation developed these three continuous electric strip annealing furnaces for bright annealing of nickel. Total load, 140 kw.; capacity, 1,200 lb. per hour of continuous strip

CONTROL CABLES CAN BE *Small*

Size, in itself, does not indicate quality. In fact, the old saying, "Good Things Come in Small Packages", very aptly describes LATOX insulated conductors. The wall of insulation varies between .012" and .018" depending upon the service.

LATOX insulated cables are good business because they eliminate or postpone the investment in larger ducts when a greater number of circuits is needed. By using LATOX cables you can get up to 300% more LATOX insulated conductors in a given size conduit than you can conductors insulated with conventional rubber insulation.

JUST OFF the press — The new book describing LATOX insulation and telling of its many properties. We will be glad to send a copy to you upon receipt of a post card or a letter.

Simplex Wire & Cable Co., 79 Sidney Street, Cambridge, Mass.

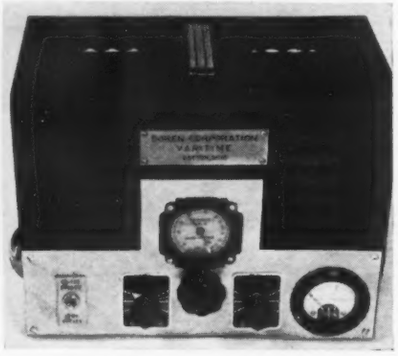
Simplex – LATOX

Thin insulation made directly from rubber latex

NEW EQUIPMENT

Synchronous Timer

Designed to supply voltage of a controllable variable frequency as well as to supply power to operate electrical devices, this timer is suggested for use in operating



"Soren Varitime;" provides an adjustable frequency range of from 18 to 240 cycles; models already produced are of 30-watt capacity. **Commonwealth Engineering Co. of Ohio,** Dayton, Ohio.

or testing small synchronous motors, clocks and similar equipment. Speed of synchronous motors can be adjusted over a five-to-one range. A system of clocks out of synchronism may be brought into synchronism with the instrument.

•

Fluorescent Lamps

Three Mazda F lamps: 100, 15 and 14 watts. **General Electric Co.,** Nela Park, Cleveland, Ohio.

New 100-watt fluorescent lamp produces a daylight quality of lamp, is otherwise similar to the previously announced 100-watt, 60-in. white lamp. Approximate initial lumens are 3,350. New 15-watt lamp produces soft-white light and is rated at approximately 435 lumens. New 14-watt lamp produces daylight quality of light and is rated at approximately 370 lumens.

•

Driver Sheaves

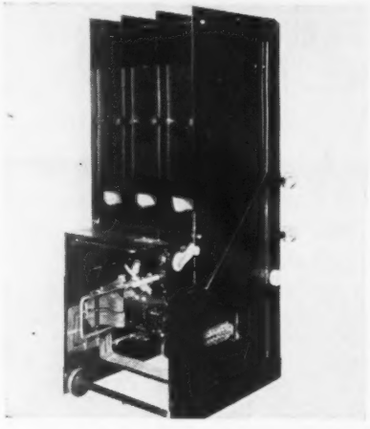
"Q-D" quick-detachable and quick-demountable V-belt driver sheaves. **Worthington Pump & Machinery Corp.,** Harrison, N. J.

New type of V-belt driver sheave is announced by this company as a standard item in its "Multi-V-Drive" line. Simplicity of construction is claimed and suitability for any application where any quick mounting of sheave to shaft, and dismounting from shaft, are desirable. In general maintenance, it eliminates necessity for a wheel puller to remove wheel or hub from shaft to get at the driving unit.

•

Air Circuit Breaker

Features of this new air circuit breaker for indoor applications include: Inlaid silver-to-silver main contacts; arcing contacts of a special tungsten alloy; isolation of high-voltage and control circuits and the "De-ion" method of arc quenching, which in this breaker employs a special magnet coil forcibly to draw out the arc quicker. High-speed operation, resulting in



Type "DH" breaker; ratings from 100,000 to 250,000 kva. interrupting capacity; 600 1,200 and 2,000 amp., for operation on 2,500 and 5,000 volts, three-phase, 60 cycles. **Westinghouse Elec. & Mfg. Co.,** East Pittsburgh, Pa.

only a half-cycle of arcing at most current values, is also a claimed feature of the unit.

Who Makes What?

"Electrical Buyers Reference," published annually. **Electrical World,** 330 West 42d St., New York, N. Y.

Names, addresses and products of electrical manufacturers are catalogued in this convenient, annual publication for public utility, industrial, engineering and other major electrical buying interests.

Maintenance Aid

Nuts on clamp-top insulators, buses or other substation equipment may be conveniently tightened with the aid of this new wrench. It has a wing nut on the side

"Tips All-Angle" insulated cog wrench; mounted on laminated hard wood pole; fits any standard socket with ½-in. square recess. **A. B. Chance Co., Utilities Div.,** Centralia, Mo.

that may be tightened to hold the wrench at an angle; the cog wheel arrangement makes it possible to turn the shank at any of the positions within a 140-deg. vertical arc simply by turning the pole. Added leverage can be secured by swinging the pole and twisting it at the same time.

•

Lamp Ballasts

Fluorescent lamp ballasts. **Acme Electric & Mfg. Co.,** Cuba, N. Y.

New line of fluorescent lamp ballasts is offered for single- or double-lamp applications of 15, 20, 30, 40, 65 and 100 watts. Testing samples are offered to fluorescent fixture builders. According to the manufacturers, the units provide performance characteristics that coincide with the requirements of the lamps they are designed to power.

•

Sheet Packings

"Ameripol" and "Koroseal" sheet packings. **B. F. Goodrich Co.,** Akron, Ohio.

Two new types of packing, one made of "Ameripol," its synthetic rubber announced last summer, and the other of "Koroseal,"

-AND SILVERY SPANGLED GALVANIZING DOES NOT ALWAYS CONVEY

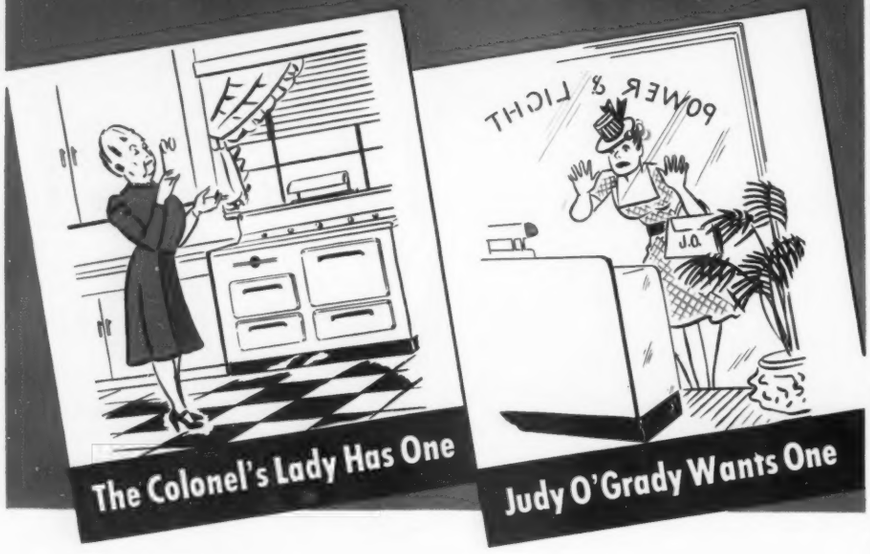
THE "INSIDE STORY" OF WHAT LIES BENEATH. IF YOU ARE LOOKING AT HUBBARD HARDWARE YOU MAY BE SURE THAT THE HEAVY, EXTERIOR COATING OF ZINC COVERS ONLY THE BEST GRADE OF NEW OPEN HEARTH STEEL, HELD TO RIGID SPECIFICATIONS, CAREFULLY INSPECTED, TESTED AND FABRICATED.

HUBBARD AND COMPANY

PITTSBURGH . . . OAKLAND CALIFORNIA . . . CHICAGO

"HANG THE LOAD ON HUBBARD HARDWARE"

The Electric Range Changes Your Judy O'Gradys from Loss-Customers to Profit-Customers!



● "The Colonel's Lady and Judy O'Grady are sisters under the skin." *Both want Electric Cooking.*

It is mostly the higher-income Colonels' Ladies who have built electric range saturation up to 10%.

Judy O'Grady represents your low-bill customer. When her bill is less than the cost of service (somewhere around $1.75, isn't it?), you lose money.

Let us show you how *Judy O'Grady's desire to have electric cooking* can turn loss-customers into profit-customers for you . . . Send the coupon below!

(For Electric Utility Executives Only, Please)

ELECTROMASTER, INC., 1803 E. Atwater St., Detroit, Michigan

Yes, we'd like to look over this plan—particularly your proofs that it works. This request puts us under no obligation.

Utility .....

By .....

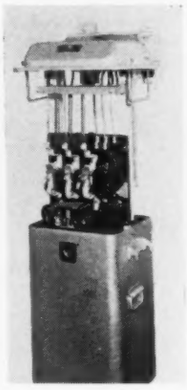
Title .....

Address .....

the synthetic elastic material, are announced by this company. Ameripol product is oil-resistant, is said to age well and to provide excellent resistance to heat and cold as well as water absorption. Tensile strength is approximately 1,500 psi., elongation 400 per cent, Shore durometer hardness 78 to 82. Koroseal packing is compounded to resist the action of oils and solvents and also resists action of some corrosives. Tensile strength is about 2,200 psi., elongation 300 per cent, Shore durometer hardness 73 to 77.

•

A.C. Starter



Oil-immersed a.c. starter with circuit breaker rated at 10,000 amp. interrupting capacity; 600 volts, 100 amp. **General Electric Co.**, Schenectady, N. Y.

Ease of installation and better protection against corrosion feature a new oil-immersed combination a.c. starter for use in corrosive or hazardous gas locations, according to the manufacturer. It is available with or without circuit breaker; one-piece head permits conduit entrance from five directions. Protection against harmful overloads is supplied by an isothermic induction-temperature relay immersed in oil. Where requirements call for explosion-proof control, the device is furnished with an extra-deep tank so that all operating parts are at least six inches beneath the surface of the oil.

•

Float Switch

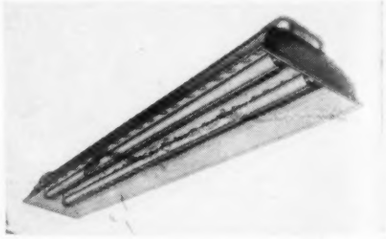
Type "J" float switch; standard inclosure or explosion-proof housing; 110, 220, 440 volts a.c.-d.c., single-pole. **Automatic Control Co.**, St. Paul, Minn.

Snap-action mercury contactor is used in this float switch. Termed a "packaged" unit, it is furnished with float, counterweight, cable or rod, bracket for mounting and screws.

•

Fluorescent Fixture

Housing two of the 60-in., 100-watt fluorescent lamps, this industrial fluorescent fixture is available with a series of apertures located in the top of the reflector directly over each lamp which permit about 2½ per cent of the light output



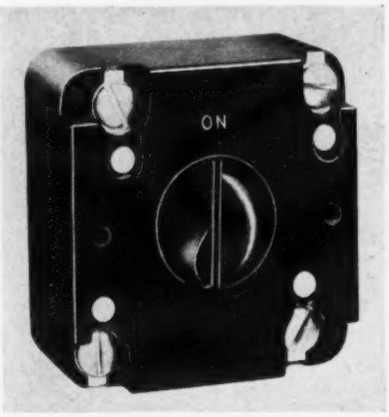
"Stream-Flo 60" fluorescent unit; porcelain enamel reflecting surface. **Benjamin Electric Mfg. Co.**, DesPlaines, Ill.

to pass upward. Protection against glare is provided by a shielding angle of 14 degrees and closed-end reflector construction.

•

Water Heater Switch

Thermally operated circuit breaker may be applied to electric or pressure oil burner water heaters and disconnects the heating



Water heater temperature limit switch; rated for 35 amp. at 125 volts, 20 amp. at 250 volts a.c. **The Hart Mfg. Co.**, Hartford, Conn.

elements or motor from the supply, should the water become overheated by a grounded heating element, defective thermostat or other cause. Switch is reset by hand. It may be connected as a double-pole, or as two individual single-pole circuits, desirable where two heating elements are used.

•

Food Cabinet

Double-size "Deepfreeze"; capacity, 66 gal. Deepfreeze div., **Motor Products Corp.**, North Chicago, Ill.

Double-size model of this company's frozen-food storage cabinet (ELECTRICAL WORLD, Sept. 21, 1940) is designed for stores, restaurants and other large consumers of frozen-fresh foods. Compressor, driven by ½-hp. motor, is placed between two "cold-cylinders" combining function of cooling element and storage box. Freon refrigerant circulates within the double walls of the cylinders.

•

Portable Fluorescents

Small portable fluorescent units have been recently announced by this company. Mounted on a variety of flexible arms, the units provide adjustability to fit the individual lighting problem. An assortment of

"No. 600" series portable fluorescent fixtures; uses one tube of 15- or 20-watt size. **The Fostoria Pressed Steel Corp.**, Fostoria, Ohio.

bases and clamps permits attachment of fixtures to different pieces of equipment, providing light for the worker where he needs it.

•

Insulating Tubing

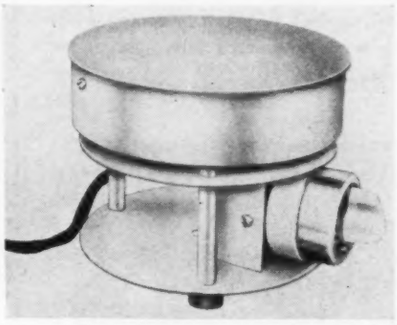
"Irv-o-volt" varnished inside-and-out tubing; "Irv-o-lite" "XTE-100" extruded plastic tubing. **Irvington Varnish & Insulator Co.**, Irvington, N. J.

Extruded plastic tubing, which it is said will maintain all its characteristics at a continuous temperature of 176 deg. F., will not lose form at 240 deg. F., is a recent announcement of this company. Dielectric strengths are 750 volts per mil, dry, and 400 volts per mil, after 24-hour soaking in water. It is stated to be unaffected by petroleum solvents, not to be attacked by a 10 per cent solution of sulphuric acid and to resist most acids and alkalis in concentrations up to 30 per cent by weight. Varnished inside-and-out tubing—not plastic—is offered for applications involving high-temperature baking, or continuous exposure to elevated temperatures and for apparatus into which hot potting compounds are poured for sealing.

•

Hot Plate

Laboratory hot plates for heat treatments, evaporations, dehydrations and digestions feature a non-warping, special alloy top to



Type "RQPH Chromalox" hot plate; for 120 or 240 volts, available in capacities from 660 to 2,200 watts. **Edwin L. Wiegand Co.**, Pittsburgh, Pa.

provide uniform temperatures. Baffles provide cool operation of switch and understructure.

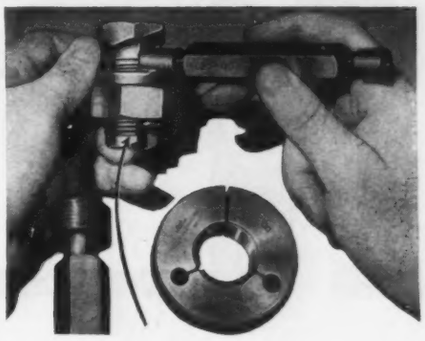
•

New Motors

"CS" squirrel-cage ball-bearing induction motors; ratings from ½ to 5 hp., with speeds from 875 to 3,600 r.p.m., for operation on 110, 220, 440 and 550 volts, two- and three-phase a.c. **Westinghouse Elec. & Mfg. Co.**, East Pittsburgh, Pa.

Smaller in some ratings, new a.c. squirrel-cage ball-bearing induction motors meet latest revised NEMA motor standards which became effective last October. Featured is the "Permanently Sealed" ball bearing said to require lubrication only once every three years. Plastic wire coating is employed to give maximum dielectric strength, toughness and flexibility. Reinforced cuffs at slot edges protect windings against abrasion and coil ends are taped to brace them against the strains of full-voltage starting.

GO, NOT-GO GAUGING



Plus — QUIK-START THREADS

Provides Advantages in your KEARNEY CON-NEC-TITES

FOR good, tight, permanent electrical connections, that will stay on your lines for years and give trouble-free service, you need uniform, precision built solderless wire connectors.

Kearney Cold Drawn Con-Nec-Tites are uniform — they are held to accuracy by means of "Go-Not-Go" Gauges. No chance of jammed or stripped threads causing hidden losses. Gauging assures proper engagement of nut on all Kearney Con-Nec-Tites.

Quik-Start threads at the end of the lead pilot provide another advantage. Nuts start on the thread with a quick ⅛th turn. Less chances of thread damage — less chance of connectors being destroyed and wasted.

Here are just two features of many that you will recognize to be important in providing protected electrical connections on your lines. And it will pay you to investigate the other features. Ask a Kearney Representative, or write, today — **James R. Kearney Corporation, 4236 Clayton Ave., St. Louis, Mo. — *Canadian Plant*, Toronto, Canada.**

JAMES R. KEARNEY

The Mark of Quality Products

UTILITY EQUIPMENT

for BETTER Construction

NEWS ABOUT PEOPLE

Wilkes Assumes Executive Duties in Shreveport

Appointment of Frank M. Wilkes of Pine Bluff, Ark., as assistant to the president and general manager of the Southwestern Gas & Electric Co. has been announced. Mr. Wilkes goes to the Southwestern Gas & Electric Co. from the Arkansas Power & Light Co., Pine Bluff, of which he has been operating vice-president. His headquarters will be in the general offices of the company in Shreveport, La.

In making the announcement, A. Lieberman, president of the Southwestern Gas & Electric Co., said: "The duties of Mr. Wilkes will consist of giving general assistance to the president in the management of the company, and he will give particular attention to cooperation with the government in plans involving electric power supply for national defense industrial requirements." In this work Mr. Wilkes will have at his

command a thorough knowledge of working out plans with governmental agencies because of the experience with the Arkansas Power & Light Co. in this field. The Arkansas company is interconnected with the T.V.A. and other public power projects.

A native of Utah, Mr. Wilkes moved to Kentucky at an early age and was reared and educated there. He obtained his early experience with the General Electric Co. in Chicago and Public Service Co. of Northern Illinois, subsequently becoming identified with the Public Service Co. of Central Kentucky and the Missouri Public Utility Co.

Following the World War he joined the Arkansas Power & Light Co. in 1919 as commercial manager. In 1920 he was promoted to operating superintendent of the company. In 1923 he was made general superintendent and a few years later promoted to general manager. In 1940 he was elected operating vice-president.

•

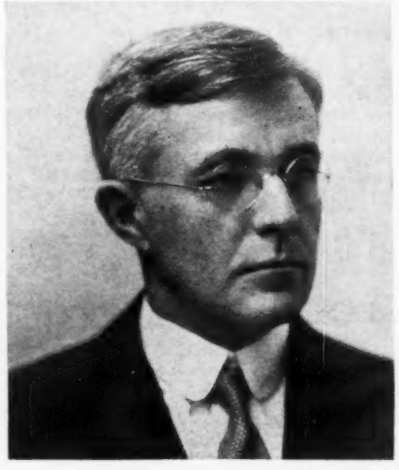
▶ N. L. Rose, since January, 1940, identified with the industrial division of General Electric Co. in Seattle, has been named manager of the General Electric's Tacoma branch. He succeeds the late Robert E. Lee.

▶ Franklin T. Griffith, chairman of the board of directors of the Portland General Electric Co., Portland, Ore., is a member of the law firm recently formed under the name of Griffith, Peck, Phillips & Nelson with offices in Portland.

▶ Frederick Krug, formerly supervisor of southern properties of the Montreal Engineering Co., Montreal, Que., has been appointed general manager of the company, succeeding the late R. Bruce Baxter. The Montreal Engineering Co. renders management and engineering services to Calgary Power Co., Ottawa Valley Power Co., Nova Scotia Light & Power Co. and Maritime Electric Co. in Canada, as well as to the international group of utilities located in Puerto Rico, Mexico, Salvador, Bolivia, Venezuela, British Guiana and Newfoundland. Before going to Montreal, in 1936, Mr. Krug was vice-president and general manager of the Porto Rico Railway, Light & Power Co.

Dr. Irving Langmuir Made President of A. A. A. S.

Dr. Irving Langmuir, associate director of the General Electric Research Laboratory at Schenectady and a Nobel Prize winner in chemistry, has been



elected president of the American Association for the Advancement of Science. He will take office at the 1941 meeting of the association in Dallas, Tex.

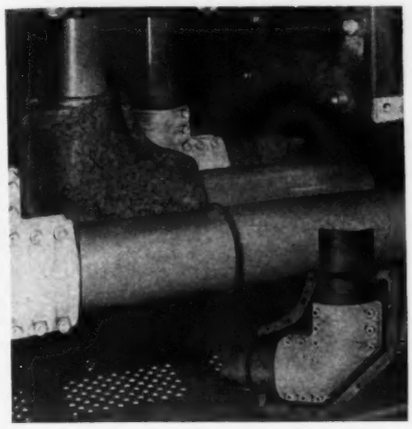
Dr. Langmuir is famous in science for his work on thin films, gas-filled lamps, vacuum tubes and hydrogen welding.

•

▶ J. L. Brown has been elected a vice-president of United Engineers & Constructors, Inc., Philadelphia. Mr. Brown has had broad experience throughout the country in engineering and construction work. He has been previously associated with Lockwood Greene & Co., Charles T. Main and Stone & Webster Engineering Corp. In 1919 Mr. Brown became general superintendent of construction for Dwight P. Robinson & Co., Inc., with headquarters in New York, and in 1928, upon the organization of United Engineers & Constructors, Mr.

Improved Bus Insulation

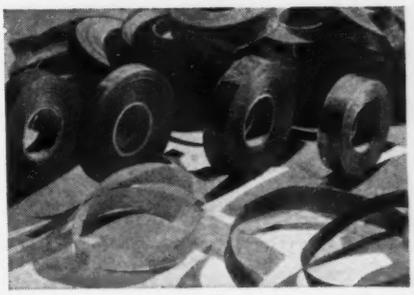
To simplify installation and at the same time increase insulation effectiveness, and dependability, a molded CELORON "boot" has been designed for use on bends in tubular bus lines. Many of these installations have now been in service for over a year and have proved their dependability.



The bus itself, as shown in the above illustration, is covered with DILECTO Insulating Tubing. This tubing is unaffected by time or moisture, can be easily cut and slipped over the bus on the assembling job. $\frac{1}{16}$" thick wall tubing will have a short time Dielectric Strength of 500 volts per mil, a maintained Dielectric Strength of 300 v.p.m.

New Fish Paper

Diamond Insulation, C-D's trade name for the commonly termed "fish paper" is now available in two grades. The new grade is synthetic resin treated so that it has much greater resistance to moisture, and higher electrical insulating properties,



without any appreciable loss in bending and other mechanical properties. Samples of this new fish paper can be had by asking for WR grade Diamond Insulation.

Silk-back Mica Tape

When there exists a limited space between armature coils and the outside of the slots into which they are placed this Silk-back MICABOND tape allows the use of just as much Mica insulation as the cheaper paper-backed tape, because of the thinness of the silk backing. Another important factor in the dependability of Silk Micabond Tape is the extreme care used in laying the Mica films, which insures highest possible insulating properties. Silk MICABOND Tape is made faced on one or both sides.

Lengthen

PRODUCT PERFORMANCE LIFE

with

C-D ENGINEERED ELECTRICAL INSULATING MATERIALS

Every time the C-D Research Laboratory studies a manufacturer's use of electrical insulating materials, suggestions usually result which improve product performance, lengthen useful life, cut costs or in some way benefit the customer.

Flashover test at 50 Kilovolts of a 15 Kilovolt DILECTO Oil Switch Bushing.

You have much to gain by allowing us to make a similar study of your needs; of course, any information which we gain through such studies is kept strictly confidential. A case in point concerns a large manufacturer seriously involved in defense work. He was getting 2 to 3 days service out of a fibre backing disc, which was being bought simply as Fibre. By furnishing a different grade of fibre we were able to furnish discs which are now averaging over 4 weeks service.

Let us study your use of laminated plastics; vulcanized fibre, mica, or other non-metallic materials. Chances are good that we'll uncover some opportunity for you to speed up production, cut down maintenance costs, improve product dependability or find some other way to help you make more money. Write us today at 12 Chapel Street, Newark, Delaware.

C-D Insulating materials are readily punched to accurate dimensions.

CONTINENTAL-DIAMOND FIBRE CO., NEWARK, DEL.

C-D Products

DILECTO—A laminated plastic possessing unusual electrical insulating, mechanical and moisture resistance properties.

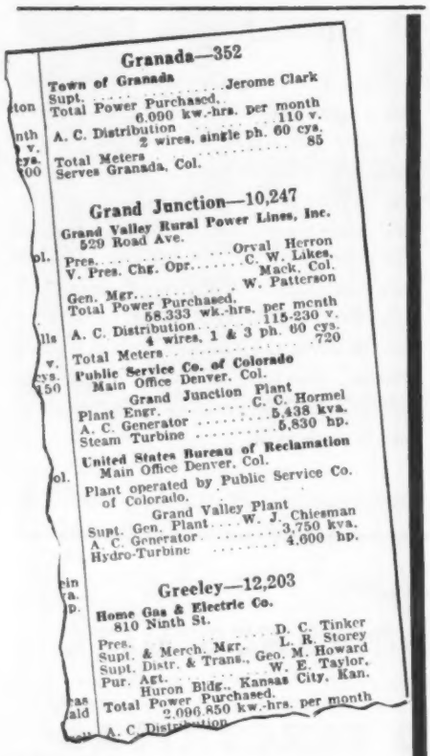
DIAMOND vulcanized **FIBRE**—A tough, hard, bone-like material of high dielectric and great mechanical strength.

CELLULAK—A specially laminated tubing with high dielectric strength and extreme resistance to flashover.

VULCOID—A laminated resinous fibre combining to a high degree the desirable properties of laminated phenolic and vulcanized fibre.

MICABOND—Mica in its most usable form—sheets, tubes, segments, rings, punched and formed parts.

CELORON—A molded phenolic fabric base plastic of exceptional mechanical strength, attractive appearance, light weight and great stability.


Granada—352
Town of Granada
Supt. ..... Jerome Clark
Total Power Purchased.
6,000 kw.-hrs. per month
A. C. Distribution ..... 110 v.
2 wires, single ph. 60 cys.
Total Meters 85
Serves Granada, Col.

Grand Junction—10,247
Grand Valley Rural Power Lines, Inc.
529 Road Ave.
Pres. ..... Orval Herron
V. Pres. Chg. Opr. ..... C. W. Likes,
Mack, Col.
Gen. Mgr. ..... W. Patterson
Total Power Purchased.
58,333 wk.-hrs. per month
A. C. Distribution ..... 115-230 v.
4 wires, 1 & 3 ph. 60 cys.
Total Meters 720
Public Service Co. of Colorado
Main Office Denver, Col.
Grand Junction Plant
Plant Engr. ..... C. C. Hormel
A. C. Generator ..... 5,438 kva.
Steam Turbine ..... 5,830 hp.
United States Bureau of Reclamation
Main Office Denver, Col.
Plant operated by Public Service Co.
of Colorado.
Grand Valley Plant
Supt. Gen. Plant ..... W. J. Chiesman
A. C. Generator ..... 3,750 kva.
Hydro-Turbine ..... 4,600 hp.

Greeley—12,203
Home Gas & Electric Co.
810 Ninth St.
Pres. ..... D. C. Tinker
Supt. & Merch. Mgr. ..... L. R. Storey
Supt. Distr. & Trans., Geo. M. Howard
Pur. Agt. ..... W. E. Taylor,
Huron Bldg., Kansas City, Kan.
Total Power Purchased.
2,096,850 kw.-hrs. per month
A. C. Distribution

THIS just gives you a quick idea of the completeness of the listings in the 1940 Central Station Directory. Check it over and see what **more** information you could want to make up market analyses . . . to help salesmen or representatives see the **right** person . . . or for quick reference for that particular bit of information you need. The Central Station Directory is a veritable encyclopedia, one that will save you dollars, cents and time.

●

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Gentlemen: You may mail us ..... copies of the 1940 McGRAW CENTRAL STATION DIRECTORY. Deliver to the following address and bill us at the rate of $25.00 per copy. (10% discount on 5 or more copies.

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(Address) .....

.....

(Signed) .....
NAME TITLE

Brown went to Philadelphia as a construction manager. He is charged with responsibility for the construction work that this company is doing for Public Service Electric & Gas Co. of New Jersey.

•

Coates Made Chairman Interstate Power Club

J. C. Coates, industrial sales consultant, Ebasco Services, Inc., was elected chairman of the Interstate Power Club, organization of power sales engineers of New York and surrounding area, at

the final 1940 meeting of the club late in December.

Mr. Coates is a product of Rensselaer Polytechnic Institute and has been in power sales work since 1922, when he was employed by the then New York Edison Co. as assistant commercial engineer. Successively commercial engineer, assistant manager of the sales department technical bureau and supervisor of the sales department plant studies division, Mr. Coates accumulated a wide experience in power sales previous to joining Ebasco in 1937.

Elected at the same time were: Secretary, Percy L. Richardson, Ebasco; directors, A. A. Kearney, Utility Management Corp.; J. P. West, Jr., Pennsylvania Power & Light Co.; J. W. Clark, Stamford Gas & Electric Co.; Robert G. Ely, Public Service Electric & Gas Co.; and J. C. Murtha, Consolidated Edison Co. of New York, Inc.

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▶ H. NEDWILL RAMSEY has been appointed purchasing agent of the Philadelphia Electric Co., in place of R. G. RINCLIFFE, who has been made manager of the station operating department. Mr. Ramsey entered the service of the American Gas Co. as engineer in 1920, and later became assistant to the general superintendent. In 1927 he became affiliated with the U. G. I., and in 1931 was placed in charge of real estate operations for the United Engineers & Constructors, Inc. Since 1934 he has been president of the Welsbach Co.

▶ McGREGOR SMITH, president of the Florida Power & Light Co., was recently appointed by Governor Cone as a member of the Florida State Council of Defense. Mr. Smith is chairman of the power and fuel committee of the council, which is an advisory and planning body to aid the federal government's defense program in Florida.

▶ GAYLORD A. FREEMAN, vice-president in charge of sales, Commonwealth Edison Co., was elected president of the Electric Association of Chicago recently. Mr. Freeman had previously served the association as a director and he remains a member of the board. W. F. SIMS, chief electrical engineer, was elected a director from the utilities group and Vice-President J. F. GILCHRIST was elected a director at large.

OBITUARY

Henry J. Blakeslee

Henry J. Blakeslee, inventor of electric meter testing equipment and founder, president and treasurer of the States Company of Hartford, died at his home in Marlborough, Conn., on January 19, of a heart attack. He was 64 years old.

Mr. Blakeslee held 30 patents on meter-testing equipment. He was formerly superintendent of the Bureau of Gas and Electricity in Syracuse and also had worked for the Hartford Electric Light Co. At a celebration of the 150th anniversary of the inauguration of the patent system, held last February in Hartford, Mr. Blakeslee was named one of thirteen "modern pioneers" of invention in Connecticut. He was a member of the American Institute of Electrical Engineers.

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Jack B. Hill

Jack B. Hill, vice-president of the America Gas & Electric Service Co., New York, died January 19 in East Orange, N. J., after a week's illness. He would have been 59 years old on January 20.

Mr. Hill joined the corporation thirteen years ago as an executive engineer. A native of Jonesboro, Ind., he was graduated from Purdue University in 1905 and successively was connected with the Union Electric Light & Power Co., St. Louis, U. S. Steel Corp. and the Westinghouse Electric & Manufacturing Co. He then joined the teaching staff of the engineering school of the

University of Iowa, where he taught for fourteen years, at the same time building up an extensive consulting practice among Mid-Western utilities. He left the university to become vice-president and general manager of the Lincoln (Neb.) Gas & Electric Light Co. While in that position he became president of the Nebraska section of the National Electric Light Association in 1926.

At the time of his death Mr. Hill was vice-president and a director of the Atlantic City Electric Co., Beech Bottom Power Co., Inc., Ohio Power Co., Scranton Electric Co. and the Wheeling Electric Co.

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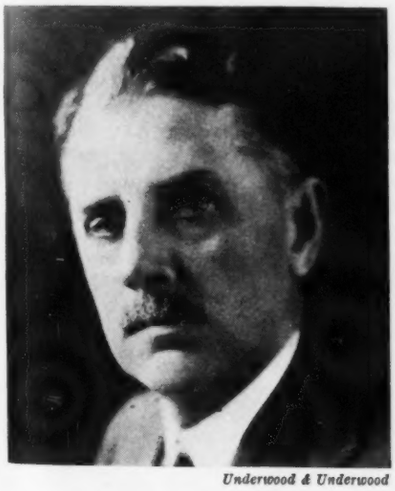
Lewis B. Stillwell

Lewis B. Stillwell, well-known electrical engineer and consultant, died January 19, in the Union Memorial Hospital in Baltimore, after a week's illness. He was 77 years of age.

Born in Scranton, Pa., Mr. Stillwell received his degree of electrical engineer from Lehigh in 1885. The next year he joined the Westinghouse Electric & Manufacturing Co., serving as chief electrical engineer from 1891 to 1897. He was an outstanding leader in the development of alternating current,



Underwood & Underwood

and had an active part in the determination of Westinghouse policy with respect to system development engineering and the establishment of 60 and 30 cycles as standard frequencies. His contributions as Westinghouse engineer to the general layout and design of the first plant of the Niagara Falls Power Co. led to his appointment as electrical director of the latter company, which position he held from 1897 to 1900.

Mr. Stillwell began his practice as a consulting engineer in New York City in 1900 and filled engagements with many companies on large and important engineering projects.

A past-president of the American Institute of Electrical Engineers, Mr. Stillwell had received from it the Lamme Medal, 1933, and the Edison Medal, 1935. The Engineering Foundation elected Mr. Stillwell chairman for four successive terms ending in 1929. He was president of the American Institute of Consulting Engineers, 1918-19.

•

T. F. English

Thomas F. English, who died suddenly at his home in South Bend on January 11 (ELECTRICAL WORLD, January 18, page 10), had been vice-president and general manager of the Indiana & Michigan Electric Co. since 1922.

A well-known and respected utility figure in the Middle West, Mr. English went to South Bend in 1922 from Muncie, Ind., where he was manager of the Indiana General Service Co. Both the Indiana and Michigan Electric company and the Muncie utility are subsidiaries of the American Gas & Electric Co. Mr. English was a director of the American Gas & Electric Service Corp.

Before going to Indiana, Mr. English was connected for several years with a utility in Covington, Ky., a property now served by the Union Light, Heat & Power Co., subsidiary of the Columbia Gas & Electric Corp.

As general manager of the Indiana & Michigan Electric Co., Mr. English had helped greatly to promote the utility's expansion of facilities and service in northern Indiana and southern Michigan and he came to be one of the best-known figures in the American utility field.

Mr. English was born in Albany, N. Y., July 3, 1876.

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▶ R. EDWARD LEE, manager of the Tacoma (Wash.) office of the General Electric Co., died in that city October 23, following a heart attack. He was educated in Orting, Wash., where he worked for the Puget Sound Power & Light Co. He was the first representative of the General Electric Co. in Tacoma, which opened an office in that city in 1914.

▶ EDMUND S. STEVENS, general appliance sales representative (electric) of the Public Service Electric & Gas Co., Newark, N. J., died December 22, in West Hudson Hospital, Kearny, after a brief illness. Mr. Stevens, who was 62 years of age, was connected with Public Service for 29 years. Starting in 1911 as a canvasser, Newark commercial, Mr. Stevens was made power representative, and assistant to the assistant business agent the following year. In 1926 he was promoted to the position he held at the time of his death.

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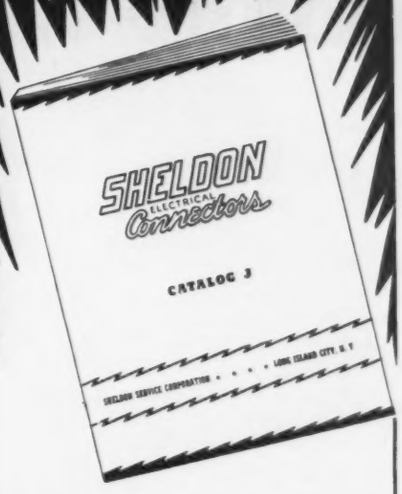

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MANUFACTURING - MARKETS

Electrical Exports Gain 27% Over 1939

Exports of electrical shipments during the first eleven months of 1940 totaled $128,051,584, as compared with $101,095,872 in the corresponding period of 1939, an increase of 26.7 per cent, according to the Electrical Division, Department of Commerce.

Foreign shipments during November amounted to $11,978,950, as compared with $11,969,800 in October and $10,550,753 in November, 1939. Rubber-covered wire shipments were valued at $175,568 in November, compared with $144,735 in October, the low month of the year. Other insulated copper wire shipments to foreign markets were valued at $468,860, a decrease of 1.7 per cent from the previous month.

Exports of motors, 1/3 hp. and under, were valued at $258,574, the peak month of the year for this item, and an increase of 220 per cent over the October total of $80,578. Shipments of electric interior lighting fixtures and parts to foreign buyers totaled $265,770, the crest for the year in this classification, and an increase of 24 per cent from the previous month.

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Circuit Breaker Contract

Allis-Chalmers Manufacturing Co. has been awarded a contract by the Bureau of Reclamation for $18,461 for oil circuit breakers for Boulder power project.

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Moves to Larger Quarters

Announcement has been made that the Standard Electrical Products Co., formerly of St. Paul, Minn., has moved to its new and larger factory and offices at 417 First Avenue, North, Minneapolis, Minn.

Machinery Business Continues to Gain

Business gains were continued by electrical manufacturers in November, as the index of value of new orders for electrical machinery advanced from 253 in October to 262 for November, 1940, as compared with 144 in November of 1939, according to the Bureau of Foreign and Domestic Commerce. In Contrast with this advance, the index of new orders for all durable goods industries dropped from 235 in October to 233 for November.

Manufacturers of electrical machinery quickened the pace of shipments during November, with the index advancing from 159 in October to 180 in November, as compared with 138 in November of the previous year. Shipments of durable goods in general slowed somewhat, with the index advancing from 167 in October to 173 for November.

SALES CONFERENCE—More than seventy representatives of Line Material Co. gathered recently at Milwaukee for the annual sales convention, during which new products, sales problems and policies were discussed

Inventories were substantially increased during November, with the index for electrical machinery rising from 122.1 in October to 125.6 in November, as against 95.4 in November, 1939. For all durable goods industries the index rose from 121.2 in October to 123.7 in November.

While unfilled orders for electrical machinery continued to pile up during November, the rate was slowed up somewhat. Electrical machinery unfilled orders increased 14 per cent over October, as compared with a 20 per cent increase for October over September; the 14 per cent increase matched the rise for all durable goods. Considering November, 1940, over November, 1939, there was a 158 per cent gain for electrical machinery as against 83 per cent for all durable goods.

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Porcelain Electrical Goods

Porcelain electrical supplies manufactured by 42 establishments in 1939 as compared with 37 in 1937 were valued at $20,817,045 in 1939, a decrease of 12 per cent from 1937, according to the Bureau of the Census, Department of Commerce. The wage earners primarily engaged in manufacturing in this industry in 1939 numbered 6,018, a decrease of 16.1 per cent from 1937 and their wages, $6,530,168, were 20 per cent less than the 1937 figure.

•

Nash-Kelvinator Order

The $1,311,250 order of Nash-Kelvinator for the United States defense housing projects received last week was for 25,000 electric refrigerators, all new 1941 models and averaging $52.50, or about half price. This order is in addition to an order of 4,000 received earlier. They are being manufactured in the Detroit plant and shipment is to start immediately.

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Noma to Pay Dividend

Announcement has been made by the Noma Electric Corp. of a 25-cent dividend. The previous payment was 30 cents, on December 21, 1939.

New York Metal Prices

	Jan. 21, '41 Cents per Pound	Jan. 15, '41 Cents per Pound
Copper, electrolytic	12.00*	12.00*
Lead, A. S. & R. Price	5.50	5.50
Antimony	14.00	14.00
Nickel, Ingot	35.00	35.00
Zinc Spot	7.64	7.64
Tin, Straits	50.15	50.10
Aluminum, 99 Per Cent	17.00	17.00

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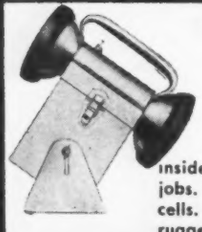
Type "T"

Roof searchlight. (Inside Pistol-Grip Control) Range one-mile. Most powerful automobile spotlight made. Swings in a complete circle, any angle, up or down. Penetrates fog and smoke. Operates from car battery.

Type "F5"

Same features as Type W.S. (above), except that it runs on 7½ v. dry cell unit (available everywhere). Available with or without running board holder.



Type "T & T"

Two-way light, gives 10-foot circle at top of pole, 20-foot floodlight for inside and underground jobs. Uses two #6 dry cells. Most powerful and rugged made.

● Even on the worst nights, the efficiency of your line repair crews, the quickness with which they locate and end outages can approach that of your day crews . . . when you make it possible for them to work in the clearer visibility made possible by Carpenter Master-Lights. No more needless groping in the dark! Customer goodwill retained at a high level! 67 types of Master-Lights,—worklights, searchlights, floodlights, warning lights, patrol lights, watchmen's lights and emergency lights for all conditions. A 30-day trial is yours without obligation. Send for descriptive literature.

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Field Reports on Business

Electrical equipment orders are being placed in good volume. Several large generator orders have been noted. Forward buying is being noted in anticipation of priorities. Appliance manufacturers are noting an increase in orders, with consumer demand in good volume.

NEW YORK

Difficulties in obtaining near shipments is increasing the trend toward stocking of future needs. Government demand for national defense is increasing the difficulties of supplying domestic needs. While this situation is not acute, many believe it will become more pronounced as defense speeds up.

Consumer demands for electrical appliances is growing and will increase this spring, in the opinion of manufacturers. Distributor and dealer reception to the 1941 lines has been good and sales forecasts have been highly optimistic. The government is in the market for refrigerators, ranges and water heaters. Government buying includes searchlight parts, electric generating sets, insulators, coils, switch boxes, cable, radio sets, arc welders, circuit breakers and wire.

The momentum of defense orders is being reflected in retail trade. Department stores report increases over last year and good demand for lamps and household electrical appliances. At the lamp show this week importers declared that they are being forced to shift to domestic merchandise because of increasing difficulties of obtaining shipments from abroad. This shift is taxing domestic production.

There was a slight decline in the index of business in the Pittsburgh district, according to the Bureau of Business Research, University of Pittsburgh. The drop is caused mainly by seasonal adjustment rather than an actual drop in physical volume of business.

NEW ENGLAND

In announcing plans for expansion on a considerable scale, several New England utilities are co-operating to the fullest extent with the government in preparing for efficient national defense. A new generating station will be built by Boston Edison Co. in Everett, Mass. It will be a tidewater location on the Mystic River, embracing a 40,000-kw. turbo-generator and a 1,200-lb., 900-deg. boiler, initial installation to be completed in 1942. Construction budgets for 1941 for Connecticut utilities total $35,100,000. Among these are Connecticut Light & Power, $2,900,000; United Illuminating, $1,000,000, in addition to $6,000,000 in plant improvements now under way; Connecticut Power, $3,000,000, and Hartford Electric Light, $4,000,000.

Connecticut Light & Power Co. is buying eleven 69-kv. oil circuit breakers. An eastern Massachusetts manufacturer has bought 275 hp. in small motors, and another recently added 25 hp. in motors. Three 15-hp. arc welders were sold about a week ago to a machine builder, and a group of fractionals aggregating over 50 hp. was booked for delivery to a central Massachusetts plant. Plant expansion which will involve large amounts of supplies for lighting and power are continuing on a large scale. A $400,000 expansion has been announced by the Reed-Prentice Corp., Worcester.

Home building projects in this area appear on a large scale for the coming year. Inquiries for commercial electrical cooking apparatus are active. Appliance sales are moderate. During the past year 2,811 electric refrigerators and 713 ranges were sold in the southern Vermont area by central stations.

CHICAGO

Orders for electrical equipment moved steadily forward as business activity continued to advance over a broad front. With the defense program embracing an increasing number of lines, the demand for electrical apparatus and service is becoming steadily greater and many manufacturers are hard pressed to make deliveries.

It appears now that one thing which may retard the high rate of industrial production will be the delays encountered in securing raw materials and parts, several instances of which have already been reported. There is increasing evidence that labor disputes may become a serious problem confronting industry as several plants in this area were shut down last week by strikes.

Retail trade has held up remarkably well since the holiday season. Department store sales last week widened the margin of gain over last year to 12 per cent. Merchants report excellent demand for electrical goods with every indication of a record year in view. Utility buying continues in good volume as construction programs are being pushed ahead rapidly.

Lindberg Steel Treating Co. will spend $50,000 for new equipment, including three heat-treating furnaces. Kellogg Company has started a $1,000,000 modernization program at its Battle Creek, Mich., plant. Approximately $790,000 will be spent for new power plant equipment, including a new 3,000-kw. turbine generator.

PACIFIC COAST

Recent and forthcoming heavy machinery orders include a steam generator unit and accessories for city of Glendale, Calif.; three 1,750-kva. transformers for Hawaiian Islands; two 2,500-kva. transformers, value $20,000, for a power company to serve a new camp area; $10,000 of armature coils and maintenance equipment for interurban service in the Bay area; 266 capacitors, size 15 kva., value $28,000, for Pacific Gas & Electric Co.; a $987,711 Westinghouse award covering drive units for 30 x 40-ft. wind tunnel at Sunnyvale, Calif.; a 300-kw. generator and equipment, value $31,000, for Mare Island radio station; four 3,000-kva. transformers for Seattle; testing equipment and the main and auxiliary controls for Grand Coulee plant, and a 4,500-kv. reactor with circuit breaker and disconnect switches for Kendrick project in Wyoming.

California Oregon Power Co. has designated $1,200,000 for 1941 extensions and rebuilding.

Recent government purchasing has concentrated upon municipal airport enlargements for Army needs, including $1,187,000 for Albuquerque, $1,000,000 for Spokane and $1,250,000 each for Boise, Idaho, and Everett, Wash. These installations are reflected electrically in many ways, floodlight manufacturers, for example, reporting a tripled business.

A Chunk of Pork

[*Continued from page 50*]

the other six dams will be authorized by the present session of Congress and contracts let on the theory that they are essential to national defense.

Just as there is almost the certainty that the Clark's Hill project in Georgia is about to get a green light, theoretically because it is essential to national defense, actually because Senator Richard Russell, as explained in previous articles in this space, knows his way around and about.

So don't let the shock affect your heart when your senator votes for something the President wants that you know personally the senator thinks is cockeyed! He's just straightening out the national defense situation back in his state. Making the engineers, and the Defense Commission, and the President, see how important that dam on Podunk Creek is to help Britain.

•

Bauer & Co. Purchases New Factory Building

Bauer & Co., Inc., Hartford, Conn., manufacturer of electric water heaters, coffee-making equipment, air-conditioning apparatus and also electrical contractors, has purchased for immediate occupancy a 21,000-sq.ft. factory building at 844 Windsor Street. John H. Bauer, president, stated that the plant at the new location has more than double the floor space of the present establishment and is better adapted to heavy manufacturing than the commercial type of building now occupied by the organization.

The Bauer organization will also establish its offices and showrooms at the Windsor Street site.

•

Standard Transformer Plans New Addition

Standard Transformer Co., Warren, Ohio, is building a $50,000 addition to be completed about February 1. The company has many defense orders and enough orders booked to assure capacity operations until at least March 1, said Worthington F. Parker, president.

The company's present orders include transformers for the Boston, Philadelphia and Puget Sound navy yards, the Opelika, Fla., air base, for defense of Puerto Rico and other army, navy and marine corps stations and camps, as well as for air fields.

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ELECTRICAL WORLD, Department MC

330 WEST 42ND STREET NEW YORK CITY

Powerton-Crawford 22-Kv. Line

[*Continued from page 31*]

voltage test was necessary because of the graded insulation on the high-voltage winding. A special testing unit was designed for this purpose. The special testing unit operates at 300 cycles. This frequency was found to result in a minimum rating for the set because on these transformers the exciting current is excessive at lower frequencies and the charging current would be excessive for higher frequencies. The generator rating is 650 kva.

This testing equipment was mounted on a special trailer which was moved directly to the transformers under test and was used at both Powerton and Crawford terminals. The trailer is 25 ft. long by 11 ft. high by 8 ft. wide. Because of its width a special permit is necessary every time the trailer is moved on a state highway.

Recent Rate Changes

CHAMBERSBURG, PA., BOROUGH COUNCIL has unanimously passed an ordinance lowering the present rate on electric energy from the borough-owned light plant by approximately 10 per cent all through the present rate schedule. Actual receipts from the light plant were approximately $35,000 more than budget estimates, it was pointed out, and J. H. Mowrey, manager of public utilities, estimated that receipts for the coming year, based upon the reduced rates, will be approximately 10 per cent above 1940. The new rates will go into effect on April 1.

COLORADO PUBLIC UTILITIES COMMISSION in a recent report to Governor Carr stated that Colorado residents will save $288,960 on their electricity bills annually as a result of rate reductions arranged during the past year.

WASHINGTON DEPARTMENT OF PUBLIC SERVICE, Olympia, has brought about $2,500,000 savings to customers by reduction of public utility rates during the past two years, and reductions totaling more than $4,000,000 since 1933, Director D. G. Abel said in his recent biennial report. Since 1933, the savings to customers of utilities as a result of the department's activities has averaged $511,000 annually, he said.

Prompt Payment Rewarded

Patrons of the municipal plant at Rising Sun, Ind., have been notified that payment of bills before expiration of ten days from date of bill will result in a 10 per cent saving in their lighting costs. The discount is made possible by a cash reserve built upon the first eighteen months of municipal operation.

Sales Opportunities

WENATCHEE, WASH.—Washington Water Power Co., Spokane, plans extensions in transmission lines in part of Chelan County, vicinity of Wenatchee. Also will make additions in distributing lines in same district. Application has been made for permission.

DECATUR, IND.—Board of Public Works, City Hall, receives bids until February 6 for ten motor controllers, hand automatic transfer switches, etc. (Contract 16); also, at same time, for municipal generating station power-operating, metering and lighting system (Contract 17). Froehlich & Emery Engineering Co., Second National Bank Building, Toledo, Ohio, is consulting engineer.

WILKES-BARRE, PA.—United States Engineer Office, Post Office Building, Baltimore, Md., receives bids until February 4 for three outdoor-type transformer substations, and about 20,000 lineal feet of overhead transmission line, and 800 lineal feet of underground lines at Wilkes-Barre. (Towers and electrical equipment for substations will be furnished by Government).

EUCLID, OHIO—Thompson Aircraft Products Co., recently organized subsidiary of Thompson Products, Inc., 2196 Clarkwood Avenue, Cleveland, Ohio, manufacturer of automotive and aircraft equipment, plans installation of motors and controls, duct lines, switchgear, power substation apparatus, industrial lighting facilities, electric hoists, conveyors and other equipment in new plant at Euclid, for production of aircraft engine valves and kindred products for government. It will comprise several one-story units, totaling about 575,000 sq.ft. of floor space, located on tract of about 100 acres of land. A power house will be built. Cost estimated in excess of $11,000,000, to be financed by Defense Plant Corp., Washington, D. C., federal agency. Work is scheduled to begin soon.

PORTLAND, ORE.—Purchasing Officer, Bonneville Power Administration, Department of Interior, 811 N. E. Oregon Street, Portland, receives bids until February 4 for current transformers as follows: Four 69 kv.; two 23 kv.; 75 15 kv.; 17 7.5 kv.; and six 5 kv. Also for potential transformers, as follows: ten 2,300 to 115-volt; 66 6,900 to 115-volt; 11 13,800 to 115-volt, and four 23,000 to 115-volt (Circular 1665).

DETROIT, MICH.—Bohn Aluminum & Brass Corp., Lafayette Building, Detroit, plans installation of motors and controls, switchgear, duct lines, industrial lighting apparatus, electric hoists, conveyors and other equipment in new plant for production of airplane engine parts for Navy Department, Washington, D. C., comprising several one-story units, estimated to cost approximately $1,200,000. Site is being selected and work will be placed under way soon. Appropriation in amount noted will be provided by Government.

MARSHALL, MO.—City Council plans expansion and improvements in municipal steam-electric power plant, including installation of new turbine-generator unit and accessories, boiler, stoker, pumping machinery and auxiliary equipment. Estimates of cost and plans will be made by Henrici-Lowry Engineering Company, 114 West Tenth Street, Kansas City, Mo., consulting engineer.

BURBANK, CALIF.—H. I. Stites, city manager, receives bids until February 4 for furnishing, constructing and installing steam generating unit and accessory equipment in new municipal steam-electric power plant now in course of construction, as per plans and specifications at office of Public Service Department, 174 West Magnolia Boulevard (Specifications 233).

PENDROY, MONT.—Montana Power Co., Butte, Mont., will furnish power supply to Sun River Electric Cooperative, Inc., Fairfield, Mont., for new rural electric system to be constructed by latter in Pondera Basin and Conrad-Ledger districts, and will install power substation and switching facilities for connection with distribution system near Pendroy. Cooperative organization will build about 100 miles of primary and secondary lines, with service facilities. Work is scheduled to begin early in March. Financing is being arranged through Federal aid.

SOUTH BEND, IND.—Studebaker Corp., South Bend, manufacturer of automobiles, plans installation of motor-generator sets, transformers and accessories, motors and controls, duct lines, switchgear, industrial lighting facilities, electric hoists, conveyors and other equipment in new plants for production of aircraft engines for War Department, Washington, D. C. Three plants will be built, one to be located on 21-acre tract of land at end of Chippewa Avenue, South Bend; another, to be built on 24-acre site near Fort Wayne, Ind.; and third to be situated near Chicago, Ill. Each will consist of main one-story units, about 400x1,000 feet, and group of auxiliary structures. Giffels & Vallet, Inc., Marquette Building, Detroit, Mich., is architect and engineer for Chicago plant noted. Entire project will cost about $36,800,000, and fund in that amount will be provided by government.

VINTON, IOWA—City Council receives bids until February 14 for equipment for expansion in municipal power plant, including new 700-kw. diesel engine-driven electric generating unit, exciter and complete auxiliary equipment. Stanley Engineering Company, Muscatine, Iowa, is consulting engineer.

ROCKVILLE, MINN.—Northern States Power Co., Minneapolis, Minn., plans extensions in power substations at Rockville, Monticello and Annandale, including installation of transformers, switchgear and auxiliary equipment for increased capacity. This will be part of 1941 expansion program of company in St. Cloud, Minn., district.

NORFORK, ARK.—United States Engineer Office, Little Rock, Ark., receives bids until February 20 for new concrete, gravity-type dam on North Fork River, vicinity of Norfork, including penstocks and supporting frames, motors and piping, electrical conduits, power and lighting system, oil pumps, etc. (Circular 58).

WILMINGTON, N. C.—Newport News Shipbuilding & Dry Dock Co., Newport News, Va., plans installation of motors and controls, switchgear, electric hoists and cranes, transformers and accessories, duct lines, exterior and interior night-lighting facilities, conveyors and other equipment in new shipbuilding plant at Wilmington, where site has been selected on waterfront, to be used for construction of vessels for U. S. Maritime Commission. Project will include six shipways, two fitting-out piers and large group of shops and construction buildings; a power house will be built. Cost reported over $3,500,000. New yard will be operated by North Carolina Shipbuilding Corp., now being organized as a subsidiary interest. Work will begin at early date.

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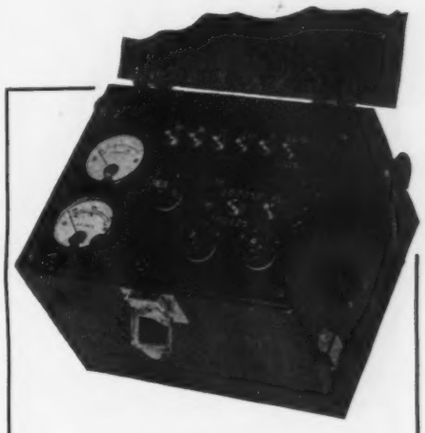

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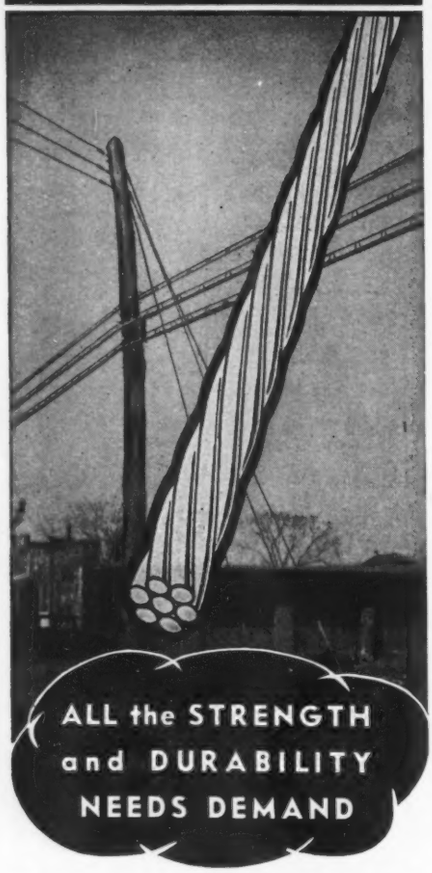

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Co-op to Serve New Army Training Camp

Harry Slattery, Administrator of Rural Electrification, recently announced allotments totaling $900,000 for rural electrification in five states, including an emergency allotment to provide for new service by a rural electric co-operative to a new army training camp near Bloodland, Mo.

The allotment for construction of a substation and 25 miles of high-voltage line to the camp was rushed through REA in record time. The co-operative will provide power from a temporary source to the contractor engaged in building the camp by about January 25, little more than a month since REA first went to work on the application. Sixteen miles of 34,500-volt will be constructed to bring in this temporary service, and this line then extended nine miles farther to the permanent substation.

Service to the camp will be provided by the Laclede Electric Co-operative of Lebanon, Mo., an REA borrower organized in 1939 to bring service to about 1,200 farms and other rural users in the area. Under the terms of the agreement between the Army and the co-operative, the co-operative will build and maintain the line, providing service to the camp at cost.

Other allotments follow:

IOWA—S. E. Iowa Co-operative Electric Assn., Mt. Pleasant, Warner A. Russell, supt., $157,000 to build 193 miles of line, 494 members in Jefferson, Lee, Henry and Van Buren counties.

KANSAS — Jewell-Mitchell Co-operative Electric Co., Inc., Ionia, Herman H. Walters, president, $198,000 to build 217 miles of line to serve 393 members in Jewell, Mitchell, Lincoln and Osborne Counties.

MISSOURI—Laclede Electric Co-operative, Lebanon, J. R. Haugh, supt., $275,000 for construction of 10,000 kw. 132/34.5 kv. substation and 25 miles of 34.5 kv. transmission line, to serve an army camp near Bloodland, Mo.

NEW MEXICO—Roosevelt County Electric Co-operative, Inc., Portales, Gayle P. Easley, supt., $100,000 to build 117 miles of line, 309 members in Roosevelt County.

TEXAS—Tri-County Electric Co-operative, Inc., Azle, M. H. Skidmore, supt., $110,000 to build 151 miles of line, 342 members in Parker, Palo Pinto, Jack, Hood, Wise and Tarrant counties. San Bernard Electric Co-operative, Inc., Columbus, M. L. Cowan, supt., $60,000 to build 85 miles of line, 188 members in Waller, Colorado, Austin, Harris and Montgomery counties.

OREGON—Malheur Co-operative Electric Assn., Vale, Ore., Leland S. Heller, supt., $17,000, to build 18.5 miles of line, 50 members in Payette County, Idaho.

Among the construction contracts approved between December 11, 1940, and January 11, 1941, are the following:

ALABAMA — Tallapoosa River Electric Co-operative, Inc., Lafayette, James F. Bevis, supt., and Gordon Persons & Co., Inc., 200½ Montgomery St., Montgomery, Ala., engineer contract to Montgomery Electric Co., Montgomery, Ala., 391 miles of line, 703 members; bid, $199,845.

COLORADO—Poudre Valley Rural Electric Assn., Inc., Severance, Roy Gans, supt., and Rocky Mountain Engineering Co., 201 Wilda Building, Denver, Colo., engineer, contract to Snyder and Johnson, Inc., Humboldt, Iowa, for build 387 miles of line, 736 members; bid, $254,037.

GEORGIA—Canoochee Electric Membership Corp., Reidsville, Homer N. Daniel, supt., and J. B. McCrary Engineering Corp., Atlanta, Ga., engineer, contract to Leo T. Barber, Moultrie, Ga., 183.6 miles of line, 373 members; bid, $96,372.

IDAHO—Lost River Electric Co-operative, Inc., Arco, H. S. Nixon, 219 Omaha Grain Exchange Bldg., Omaha, engineer, contract to Lessinger Plumbing & Heating Co., 221 South Tenth St., Boise, Idaho, 86.5 miles of line, 214 members; bid, $61,405.

ILLINOIS—McDonough Power Co-operative, Macomb, Ray Grigsby, supt., and E. G. Mull, Blandinsville, engineer, contract to Cater Construction Co., Blue Springs, Mo., 226.6 miles of line, 457 members; bid, $169,415.

INDIANA—Dubois Rural Electric Co-operative, Inc., Jasper, R. C. Lennox and J. C. Matthews, 833 Architects' and Builders' Bldg., Indianapolis, engineer, contract to C. A. Hooper Co., Madison, Wis., 388 miles of line, 1,219 members; bid, $240,384.

IOWA—Winnebago Rural Electric Co-operative Assn., Thompson, Glenn Bergland, supt.,, and Stanley Engineering Co., Muscatine, engineer, contract to K. T. Hugo, 332 Wheeler Av., Mankato, Minn., 126 miles of line, 261 members; bid, $82,568.

KANSAS—Flint Hills Rural Electric Co-operative Assn., Inc., Council Grove, M. D. Leslie, supt., and Paulette and Wilson, Topeka, engineer, contract to R. E. Mattison and Co., P. O. Box 492, Britten, Okla., 295 miles of line, 517 members; bid, $184,954.

KENTUCKY—South Kentucky Rural Electric Co-operative Corp., Somerset, F. D. Gregory, supt., and Pat M. Sullivan, Gallatin, Tenn., engineer, contract to W. A. Smith, Heyburn Bldg., Louisville, 255 miles of line, 1,112 members; bid, $162,614.

MINNESOTA—Lyon-Lincoln Electric Co-operative, Inc., Tyler, Sigvald C. Martensen, supt., and United Engineering Service Co., 1406 W. Lake St., Minneapolis, Minn., engineer, contract to Acme Construction and Martin Wunderlich Co., St. Paul, 188 miles of line, 247 members; bid, $99,905.

MISSISSIPPI—Pearl River Valley Electric Power Assn., Columbia, C. M. Crews, supt., and Francis and Haley, Birmingham, Ala., engineer, contract to Oman Construction Co., Nashville, Tenn., 6.5 miles of 110 kv. three phase transmission line and necessary substation facilities to supply U. S. Army at Camp at Shelby, Miss.; bid, $134,560.

MISSOURI—Laclede Electric Co-operative Lebanon, J. R. Haugh, supt., and Rural Line Engineers, Central Bldg., Clayton, engineer, contract to George B. Heath, 3829 W. Pine Blvd., St. Louis, 316.9 miles of line, 525 members; bid, $201,851.

MONTANA—Big Horn County Electric Co-operative, Inc., Hardin, Carl H. Meister, supt., and J. M. Garrison, State Water Conservation Board, Helena, engineer, contract to Peter Kiewit Sons Co., 1024 Omaha National Bank Bldg., Omaha, 165.66 miles of line, 453 members; bid, $150,395.

NORTH CAROLINA — Piedmont Electric Membership Corp., Hillsboro, John T. Alderman, supt., and B. O. Vannort, 1207 Commercial Bank Bldg., Charlotte, engineer, contract to Miller Baxter Co., Inc., 445 N. Pennsylvania, Indianapolis, 130 miles of line, 375 members; bid, $86,000.

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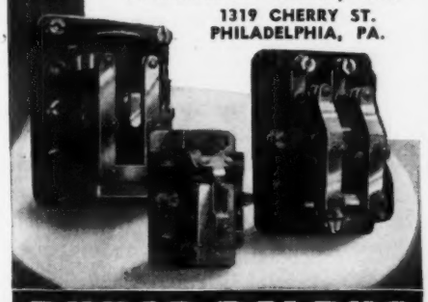

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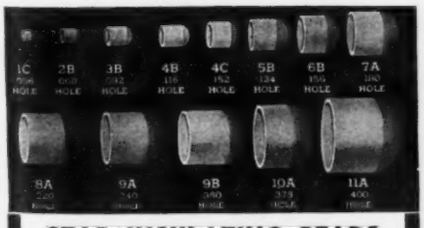

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Man-Power Maintenance

[*Continued from page 43*]

to women employees. A monthly bulletin is published by this group.

A personnel rating report is included in the data obtained in each employee's progress report file and is based on a personnel survey made every two years when each employee is rated by his or her supervisor, and by the manager of the department. In addition, should any rating not accord with the evaluations of the personnel office, either negatively or affirmatively, this is specified in the report.

The employee is rated on ten counts—personal appearance, application, tact, initiative, leadership, judgment, ability to supervise, loyalty, performance, and physical condition. In each instance the supervisor and manager state whether the rating shall be excellent, very satisfactory, satisfactory, unsatisfactory. Also, special ratings are given to indicate adaptability for promotion. For instance, an "A1" rating would indicate that the employee was definitely entitled to serious consideration for promotion to superior positions in his own or any other department or division, while an "A2" rating would indicate that the individual was due for a promotion, but for personal reasons, preferred no consideration for transfer or promotion.

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Frank McLaughlin, president of the company, recently made this statement: "The company appreciates that its employees are human beings with hopes and aspirations, with a desire to go on and better themselves. That's why we are glad to announce that last year there were 372 promotions. The more the merrier. We are looking forward, not back, and we rejoice at the progress of our associates. There is no substitute for brains, ability, loyalty and hard work. The best thing in life is to see men and women achieve the destinies which are rightfully theirs."

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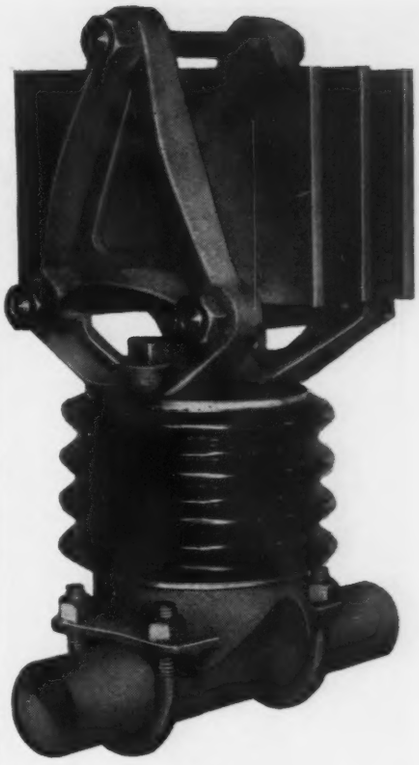
Chelsea Fan & Blower Co., Inc., has purchased a new plant in Irvington, N. J., and will move into the new quarters on February 1.



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Transformer Characteristics Affect Distribution Design

[*Continued from page 37*]

be kept down? Edison Electric Institute committees have made quite a study of the best distribution of copper and iron losses in a transformer, and any one can apply these studies to his particular conditions. If a company purchases all or part of its power requirements, it is possible that transformer losses should be considered as purchased power and valued accordingly.

If we assume that the product of iron and copper losses must be constant to hold the transformer price constant, we obtain the following equations:

x = iron loss in watts
y = copper loss in watts
a = annual cost of iron loss per watt
b = annual cost of copper loss per watt
z = annual cost of losses $= ax+by$ (1)
c = constant value of x times y (2)

$$r = \frac{y}{x} = \text{ratio of losses} \quad (3)$$

$$z = ax + b\frac{c}{x} \quad (4)$$

$$z = ax + bcx^{-1} \quad (5)$$

$$\frac{dz}{dx} = a - bcx^{-2} \quad (6)$$

For minimum value of z:

$$\frac{dz}{dx} = O = a - bcx^{-2} \quad (7)$$

$$bcx^{-2} = a \quad (8)$$

$$x^2 = \frac{bc}{a} = \frac{brx^2}{a} \quad (9)$$

or $$r = \frac{a}{b} \quad (10)$$

Therefore the *most economical ratio of copper loss to iron loss is the ratio of the annual cost of iron loss to the annual cost of the copper loss.*

We have concluded that our losses on peak are worth \$15 a kilowatt-year and that energy used in losses is worth \$0.002 per kw-hour for iron losses and \$0.0025 per kw-hour for copper losses.

Annual cost of iron loss = \$15 + 8,760 × 0.002 = \$32.52 per kw.

We estimate that each kw. of copper loss uses 5.7 kw-hr. per day, or 2,080.5 kw-hr. per year.

Annual cost of copper loss = \$15 + 2,080.5 × 0.0025 = \$20.20 per kw.

$$\frac{a}{b} = \frac{0.03252}{0.0202} = 1.61$$

This compares to the ratio of 3 used on most present-day distribution transformers. A decrease in load-loss factor would be necessary to reduce the annual cost of copper losses and increase this ratio. As our assumed loss factor is now only $\frac{2,080}{8,760} = 23.7$ per cent, such reduction appears out of line. Edison Electric Institute publication F-3 shows loss factors generally higher than our assumption.

Lower Copper Proportion

The trend toward lower ratios of copper to iron loss is shown in a line of transformers recently put into production where this ratio is from 1.68 to 2.61. This seems a step in the right direction. At the same time reactance has been reduced along with the resistance. Fig. 4 shows the effect of these transformers upon the curves previously shown in Fig. 3. The resistance in the two smallest sizes has been reduced below any previously available as standard units, while that of two other sizes has almost equaled the previous lows. The reactance in these sizes has been very materially reduced, almost to the previous lows, while that of the fourth size is about the average of other present-day transformers. The coil construction is such that the increased short-circuit stresses probably have no more effect than on previous coil designs.

If manufacturers in general will recognize these problems of the distribution engineer, we may expect to see more changes toward higher core loss, lower copper loss, lower reactance and lower resistance without any increase in cost of the transformer and without sacrificing any of the many admirable qualities of transformers which have heretofore been produced.

A further use of Fig. 4 is shown in the curved line intersecting all of the various size transformer curves. This can be drawn, as shown, to represent an upper limit of desirable reactance and resistance, or for relocation to suit other requirements. As more manufacturers follow the trend mentioned, this curve can be lowered with sufficient competition remaining to satisfy any purchasing agent.

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Limits Office Holding

Attorney-General Smith Troy of Washington has recently rendered an opinion at Olympia which states the office of County Commissioner and PUD commissioner are incompatible. The opinion was for Prosecutor R. L. Ponder of Lewis County, who said a PUD commissioner had been elected county commissioner.

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LETTERS TO THE EDITOR

Eight Times Illumination With Equal Wattage

To the Editor of ELECTRICAL WORLD:

The article in the September 7 issue of ELECTRICAL WORLD entitled "85 Foot-Candle Drawing Room Lighting," by Walter J. Leemhuis, tends to create a false impression as to the relative efficiencies of fluorescent and incandescent lighting systems.

In its opening paragraph it specifically states that "without changing the wattage the illumination has been increased eight times from 11 to 85 foot-candles." This would indicate a relative efficiency between the two systems of eight to one in favor of fluorescent. Let us examine the facts according to the data set forth in the article. First, the writer says that the old incandescent system consisted of 200-watt incandescent lamps in inclosing glassware spaced on 8 x 10 ft. centers in a room 63 ft. wide by 190 ft. long and that the load was 37 kw., or about 3.3 watts per square foot. In the first place 10 x 8-ft. centers is 80 sq.ft. per outlet, which, with a 200-watt-lamp, would be 2½ watts per square foot instead of 3.3 as stated.

If we assume that the 37-kw. figure was accurate and take the room area of 11,970 sq.ft., we find 3.09 watts per square foot; this would indicate 185—200-watt units, and we will assume that this figure is correct as it is based on a specific kilowatt load. From the photograph of the installation shown, the previous fixtures were Ivanhoe "Trojan" inclosing globes. Delving into the Illuminating Design Data Booklet published by the lamp department of the General Electric Company, and assuming a 10 to 11½-ft. mounting height, which should be maximum for the spacings indicated, we find a room index of "B" and a co-efficient of utilization of 0.55, or 55 per cent. This is true for a condition with ceilings of 75 per cent reflection factor and walls of 50 per cent reflection factor, which is a conservative condition in a modern plant. We also find from this data that the maintenance factor—that is, foot-candles maintained in service—should be approximately 75 per cent of initial foot-candle levels. We therefore find that the initial foot-candle level produced by this incandescent system should have been 31.5 foot-candles, which, at 75 per cent maintenance factor, would be 23.6 foot-candles in average service, which is

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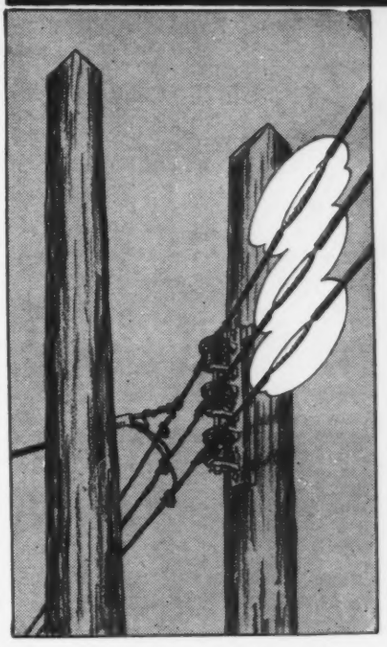

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slightly above the 11 foot-candles stated.

Now let us analyze the fluorescent system. The 48-in. lamps operating on tulamp auxiliaries have a rated wattage of 48¾ watts per lamp, including auxiliary losses, or a total for the 826 lamps of 40,267 wattts, instead of 37,000 as Mr. Leemhuis states. Perhaps he neglected to mention the wattage consumed by auxiliaries, as many of his predecessors have done. This would be 3.37 watts per square foot instead of 3.3 as stated. But perhaps this error could be considered minor.

The new Design Data Bulletin for fluorescent lighting, issued recently by the lamp department of the General Electric Company, shows that the room index with these units mounted flush on a 14-ft. ceiling would be "C" and that the co-efficient of utilization for this room index and this fixture would be 0.57. The maintenance factor is not known for this fixture, but inasmuch as the figure given for an incandescent RLM dome is 0.75, we see no reason why this fixture should be any higher. We therefore would have 826 times 1,800 lumens times 0.57 divided by 11,970 sq.ft. which would give us 70.8 initial foot-candles times 0.75 maintenance factor would give us 53 foot-candles maintained in service instead of the 85 stated.

We therefore have here described an incandescent system using 3.09 watts per square foot, which, with reasonable maintenance, should have been producing 23.6 foot-candles in average service, replaced by a fluorescent installation which, under the same conditions, would produce 53 foot-candles in average service using 3.37 watts per square foot. If we adjust the fluorescent installation to the same wattage as the incandescent, that is, 3.09, we find that 53 foot-candles divided by 3.37 and multiplied by 3.09 would be 48½ foot-candles for the same wattage per square foot as used in the incandescent installation. We therefore have a ratio of almost exactly two to one in favor of the fluorescent between the two systems.

We do not mean to say that it is not possible to have had only 11 foot-candles with the old incandescent installation and to have obtained 85 foot-candles under the fluorescent installation when it was first installed. However, the 11-foot-candle level obviously could only have been reached under terribly unfavorably maintenance conditions with a considerable accumulation of dust and dirt, dirty walls and ceilings and possibly improper voltage lamps, and the 85 foot-candle level for the fluorescent could only have been secured as a pre-initial condition. In other words, readings taken before the lamps had operated their 100-hour seasoning period which is necessary to reach the rated output. Further than this, it would be with brand new fixtures, fresh reflecting surfaces, light colored walls and ceilings and a complete absence of dirt accumulation. It is therefore obvious that to rate the two systems as to relative efficiency, based on the worst possible conditions in the one case and better than ideal conditions in the other, is highly misleading.

We do not in any way wish to deprecate this 50-foot-candle fluorescent installation, which is very fine and well deserving of the publicity given it. What we are criticising is the fallacious optimism of making such comparisons for purposes of publication which are obviously based on highly depreciated and terribly inefficient maintenance conditions for the incandescent system and pre-initial foot-candle readings for the fluorescent installation. This type of publicity seriously handicaps the efforts of conscientious engineers who are trying to promote fluorescent lighting on a high plane of accuracy and truthful information.

L. B. Paist, Supervisor
Lighting Sales Department,
Northern States Power Company,
Minneapolis, Minn.

To the Editor of Electrical World:

I have gone over this comment in considerable detail and I must admit to an error in calculating the total load for the fluorescent installation. This error resulted from a misunderstanding as to the wattage loss occurring in the ballast. This value should have been approximately 4.0 kw., or 3.38 watts per square foot. The ballast loss is 17.5 watts for a two-lamp, or 8.75 watts per lamp.

I note also that the reader caught an error which presumably occurred in calculating the wattage per square foot for the filament installation. Actually this was 3.3, because the filament lamps used were the 300-watt instead of the 200-watt shown in the copy. There were 124 300-watt Trojans on 12 x 8-ft. centers, not 10 by 8. This gives a total of 37.2 kw. In addition, there was about 2 kw. of supplementary lighting, giving a total load of 39.2 kw., or, at 11,900 sq.ft., 3.3 watts per square foot.

It is true that on a design basis the illumination would be considerably higher than that actually found in this installation with the filament system. The illumination values shown were actual measurements taken just prior to the removal of the old installation. The lighting equipment and side walls were quite dirty, hence the low read-

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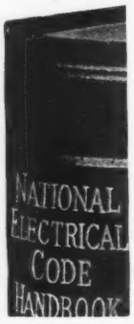

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ing. Actually the reflection factor was in the neighborhood of 25 per cent instead of the 50 per cent indicated in the reader's comments. Furthermore, the ceiling was of the open-truss construction, consequently there was further loss from this. Perhaps these details should have been included in the story to eliminate the possibility of just such a misunderstanding occurring. They do make a considerable difference in the end result as you can see.

As to the comment on foot-candle measurements, I took measurements two months after the installation was in, which would take care of the 100 hours burning, and the meter read better than 90 foot-candles. Applying the 10 per cent correction factor, the foot-candles in service would, therefore, be approximately 85. I am loath to believe that there was any great error in these readings, because they were checked by several different people both inside and outside our organization.

One of the things about this article that doubtless aroused comment was the subhead which was used. I must disclaim all responsibility for this. I assume it was written by one of your staff because it did not appear on the copy which I sent to you.

W. J. LEEMHUIS,
General Electric Company,
Pittsfield, Mass.

[NOTE: As for the subhead, we merely divided 85 ft.-candles by 11 ft.-candles as given and got approximately 8. The article stated that the wattage was the same in both cases. There was nothing in the subhead that was not in the article.—EDITORS.]

•

Canada Shows Decrease in Secondary Power

Firm power produced for consumption in Canada reached a new high in November at 2,079,984,000 kw.-hr., against 2,072,232,000 kw.-hr. in October. Deliveries of secondary power to electric boilers were light at 259,384,000 kw.-hr., against 637,114,000 kw.-hr. the year previous. Exports to the United States increased from 155,247,000 kw.-hr. in November, 1939, to 185,492,000 kw.-hr., but the increase here was all in secondary power, the exports of firm power declining from 120,357,000 kw.-hr. in 1939 to 109,787,000 kw.-hr.

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